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CHILD DEVELOPMENT

In this number there are reports of studies of suggestibility in children, of racial differences in manual dexterity, of the development of perception; also of anatomical development in youth and of play preferences and appreciation of stories by children.

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Motor Suggestion in Children

ROBERTA STEVENS WHITE

THE term suggestion has been used to cover such a wide variety of phenomena that it is necessary to define carefully the type under consideration and differentiate it from the other uses of the term. A rough classification of the various definitions may be made under the three headings of sensory, ideational, and motor suggestion. Sensory suggestion seems to mean merely illusions of sensation occurring under some special condition of expectancy, emotion, or the like. Ideational suggestion is clearly stated in MacDougall's (23) classic definition, "Suggestion is a process of communication resulting in the acceptance with conviction of the communicated proposition in the absence of logically adequate grounds for its acceptance."

Motor suggestion, the type with which this study deals, is more difficult to define concisely. Baudouin (2) characterizes it as "the automatic activation of an idea;" Hilger (12) as "the dynamic nature of ideas." Morgan (24) makes the statement that "every idea of an action will result in that action unless hindered by a competing idea or physical impediment." Hartenburg (11) names this active suggestion or "the excessive impulsiveness of ideas."

Some writers, among them MacDougall (23), do not call this suggestion at all, but class it as simple ideo-motor activity, or unconscious imitation. Dunlap (8) objects to this terminology and substitutes the phrase "similitude reactions" which are "sometimes said to be unconscious imitations, but such is not really the case. They are not reflective it is true; they are unintentional; but there is perceptual consciousness involved in each one of them." Ladd and Woodworth (17) deal with the question of the unconscious nature of the phenomenon in a clear and objective way: "Certain ideas lead to certain definite movements with which they have become associated by past experience. They may do so either with or without the full consent of the subject. When an idea leads to its appropriate movement with the full consent of the subject, we call it voluntary movement, but when the idea leads to movement, as it always tends to, while the subject's attention and intention are elsewhere directed, the movement is often named ideo-motor." There is thus a graduated scale from wholly conscious purposive imitation to, at the other extreme, the involuntary carrying out of a suggestion of which one is more or less unconscious, acting as an automatom. This might equally as well be called involuntary imitation or any one of the other dozen names which have been applied to it.

The definition of Ladd and Wood-

worth (17) contains an adequate theoretical explanation. Ideo-motor activity is a specialized type of habit formation in which the act is more or less involuntary and outside the focus of attention. Humphrey (13) upholds the same view, though he interprets imitation in terms of the conditioned reflex, saying it "may be defined as action involving a conditioned reflex the secondary stimulus of which is similar to the reaction." He adds that these relatively elementary and unconscious units of imitation form a part of a larger and undoubtedly conscious system. It is the isolation and measurement of such simple elements of action in the young child that this study aims to achieve.

PREVIOUS EXPERIMENTS WITH ADULTS

The bulk of experimental work dealing with suggestion has been carried on with adult subjects. A large part of this treats only sensory and ideational suggestion, which do not concern us here. The first study of motor suggestion was Jastrow's (14) experiment in 1892. He devised an automatograph to record the involuntary motion of the hand and head. His results show movement toward the object of attention and oscillation with the beat of the metronome or pendulum. Solomon and Stein (32) used a planchette whose action was similar to that of the automatograph. They found a general tendency to involuntary movement as soon as the attention of the subject was removed. They were able to develop a high degree of proficiency in automatic writing, which they explain as the unconscious passage of sensation into motor reactions.

Pearce (27) investigated the motor response to dermal, auditory, and visual stimuli, asking the subject to localize a stimulus, at the same time giving a second one near the spot where the first had been. It was found that this second stimulus or suggestion caused an error in localization varying with its intensity and distance from the first.

Brand (6) studied the effect of verbal suggestion upon the estimation of linear magnitudes, concluding that purely formal and arbitrary suggestion produces a definite though slight effect. Smith and Sowton (31) report the same results. Bell's (3) work was similar, showing the effect of suggestion on the reproduction of triangles and point distances. Both auditory and visual suggestions were used. There were decided individual differences in susceptibility to suggestion. Jones (16) found that suggestions of ability and inability also influenced reproduction of distances. Variability and error were less with affirmative than with negative suggestion, but least of all with no suggestion.

Strong's (34) work dealt with the effect of suggestion on muscular activity measured by the dynomometer. He found that suggestion as a whole heightens the maxima above neutral, the negative more so with some subjects and the positive with others. In comparing his results with those of Jones, Strong points out that suggestion hinders when accurate work is to be done, but helps when mere amount of muscular effort is wanted.

Starch (33) in his study of unconscious imitation of handwriting, 1911, was the first to use a large group of

subjects. One hundred and six students wrote words and sentences from copies of different kinds if handwritten and typed material. Three of the subjects purposively imitated the copy. Their results were discarded. All of the remaining 103 subjects showed a change in size and slant of their writing in accordance with the type of material copied. The men showed a greater tendency towards imitation than the women.

Langfeld (18) has studied the effect of positive and negative instructions on voluntary movement. The negative method is supposed to be a suggestion towards poorer work. He used a tracing board with both types of instructions. In general his results show that the best work is done with positive instructions, though great variability exists.

PREVIOUS EXPERIMENTS WITH CHILDREN

The experimental work dealing with child subjects falls naturally into two chronological divisions. Binet (5, 6) and the other workers at the beginning of the century were chiefly concerned with devising tests to measure the trait called suggestibility, and applying them to children in the hope of finding individual and age differences. Since 1920, however, the trend has been away from individual measures towards the use of a battery of tests in attacking some specific problem, either theoretical or practical, in the field of suggestion.

Practically all of the earlier tests dealt with sensory and ideational suggestion. Otis (26) has summarized a number of these. Most of the results agree in indicating an inverse relationship between age and suggestibility as measured by this type of test.

Very few tests of motor suggestion have been applied to children. Jastrow (14) in his original work with the automatograph used one child subject, a boy of eleven who showed extensive and coarse movement. With the same apparatus Tucker (36) made a comparison of the involuntary movements of 18 adults and 25 children. He found no definite tendency to move toward a seen object if it was thought of as at rest. A moving stimulus produced imitative movements in the direction of its motion. Children were subject to these laws to a less degree than adults. No sex or age differences among them were discernable.

Binet (4) contributed several ingenious tests of motor suggestion. Two he classed as experiments on subconscious movements. The child passively held one end of a balance which the examiner moved in rhythm with the beats of a metronome. This movement was gradually discontinued and in many cases the child would carry it on automatically. In a similar manner Binet attempted to produce automatic writing. He remarks that these automatisms do not appear to coincide with automatisms of judgment. Simon (30) repeated the tests on abnormal children using a pendulum. Giroud (10) used Binet's methods but gives no results. A second type of motor suggestion is tested by Binet as "submissive imitation." The children are studied in groups to find the extent to which they will imitate the words and drawings of others. Binet also describes several types of automatisms

which he investigated but did not develop as tests because they revealed little in the way of individual differences. One of these was similar to a method used with preschool children in this study. Subjects were asked to make a circle exactly three centimeters away from one which was drawn on a sheet of paper. The tendency to make the second equal in size to the first was almost universal.

In more recent years tests of motor suggestion have been developed by various authors and used in batteries for the investigation of some specific problem. Sherman (29) reports 2 in her study of the relative suggestibility of normal and mentally defective children. One showed the effect of pointing arrows in tracing a path, the other the effect of pointing hands upon choice. The results indicate that "both normal and mentally defective children were suggestible in all of the tests used, and that in both groups of subjects suggestibility was related to their development."

Aveling and Hargreaves (1) conducted a series of tests to study the effect of personal prestige on suggestion. Five of the tests dealt with sensory and ideational suggestion and are described in Whipple's manual (38). In addition there were 2 tests of their own invention, Hand Rigidity and Hand Levitation. In these the experimenter used verbal instructions to induce an affect of rigidity or of lightness in the hand of the subject. These last two tests, together with the illusion of warmth test and line lengths by personal influence, were situations in which personal prestige was the most conspicuous element. In the three other tests the personal factor was at a minimum and suggestion was of the "non-prestige type." It was found that the frequency distributions of scores varied in accordance with the type of test. Those tests in which the prestige factor was low gave a normal distribution, showing that all subjects were suggestible in varying degrees. Those in which the personal factor was dominant presented a "U" type of curve, owing to the development of contra-suggestibility in a number of cases.

Estabrooks (9) interpreted the results of Aveling and Hargreaves (1) in terms of emotion. He believes that the "U" type of curve in prestige tests is the result of the "All or none" principle which responses tend to follow when accompanied by strong feeling tone. If such be the case, suggestibility in this type of test should correlate closely with the psycho-galvanic reflex. To demonstrate this proposition he conducted an investigation on boys whose mean age was 11.5 months. The psycho-galvanic reflex and three tests of suggestibility were used, illusion of an electric shock, material-weight illusion, and a "Bob Test." This was a modified Chevreul's Pendulum. An iron bob on an 18-inch string, which the child held, was hung in a glass tumbler. Suggestions as to its movement were given and the time recorded until it swung enough to touch the side of the glass. This Bob Test and the electricity test were designed to include a strong factor of emotion. The distribution curve of results is of the "U" type. In the material-weight illusion personal influence was eliminated as much as possible. Here a

typical curve of normal distribution resulted. Correlation between the tests and with the psycho-galvanic reflex were negligible. Estabrooks concludes that "in tests for suggestibility we do tend to get the "All or nothing" type of response when strong emotion is concerned, and that the resultant U-curve tends to become normal as this emotional element recedes. This is especially so if it is superceded by an element of intellectual discrimination." He believes that this non-prestige type of reation should be called "illusibility" rather than suggestibility.

This analysis of the experiments on motor suggestion with child subjects shows that practically no work goes below the level of six years. The only exception is Mosse's (25) investigation of the therapeutic value of suggestion on 22 children from three to six years of age. He gave them a fake medicine with the suggestion that it would produce immediate urination. In all of the cases the suggestion was effective.

To find material using subjects below school age it is necessary to look to studies of contrary suggestion or negativism. According to MacDougall (22) this converse of suggestibility results when unpleasantness has been connected with the stimulus in the past. Bridges (7) says it is a defense reaction against hyper-suggestibility. If this be true, measures of resistance will be valuable as indications of suggestibility.

Levy and Tulchin (19, 20, 21) made an extensive study of the resistance of infants and children during mental tests. Nine hundred and eighty-three subjects were grouped according to the amount of resistance shown, the criterion being refusal to take the tests. The results show a gradual rise from a low level of resistance at six months to a high point at thirty to thirty-six months, then a rapid fall to a low limit from forty-eight to fifty-four months. Nelson, in a report edited by Thomas (35), presents the results of another study of resistance in the mental test situation. The Merrill-Palmer Performance and Kuhlman-Binet tests were given to 28 children whose chronological ages were from eighteen to forty-eight months and mental ages from thirty to seventy-two months. Though the number of cases is small the results point to a definite decrease of negativism with increasing chronological age, mental age, and intelligence quotient.

Reynold's (28) study of negativism bears this out. She used 229 children from twenty-one to sixteen months in age, placing them in 13 successive situations where negativistic behavior might be manifested and giving a score of one for each instance where it appeared. Her results show that negativism wanes consistently with age.

PRELIMINARY EXPERIMENTATION

The historical summary makes it clear that very little work of the type classed as motor suggestion has been done on children, especially those of preschool age. This made it necessary to devise tests which would measure this trait, the involuntary translation of a perception into bodily activity.

There were certain conditions which such a test had to fulfill. In the first place the reaction required of the child had to be of such a simple nature that it would be well within the power of a

three year old child to perform, and preferably within the ability of a two year old. If the tests were too difficult, the variations in motor ability among the children would entirely obscure the effects of suggestion. In the second place, the attention of the child had to be distracted as much as possible from the suggestion so that purposeful imitation would be eliminated. Nor should submission to the personality of the experimenter play an undue part. Finally the test must be one to hold the interest of the child.

The 8 experiments which were devised met these conditions more or less successfully. Each was given to a small group of subjects to test its applicability to the problem. All except the last two were found to be unsatisfactory as measures of the trait under consideration and so were not continued in the major study. A brief report of each is given to show the evolution of the technique finally adopted.

1. Tracing path

In her study of motor coordination Wellman (37) makes the statement, based on Langfeld's work, (18) that positive instructions will result in greater success than negative. This seemed to be a clear-cut case of the idea of an action producing that action whether the subject wills it or no. To test this assumption the tracing path test used by Wellman was given to 43 children between the ages of 2:7 and 6:3 years, under the two types of instructions. (Throughout this study age will be so designated in years and months. Thus 2:7 means two years and seven months.) Eighteen of the children took the test 4 times, twice under the positive and twice under negative instructions. Twenty-five took it twice, once with each type of procedure. At least a week's time invened between each test. The order of giving the 2 kinds of instructions was varied with the different subjects so as to minimize the effects of practice. The 2 types of procedure were as follows:

Positive instructions. The child was seated at a table of comfortable height. Before him was placed a sheet of paper on which had been drawn two "tracing paths" (37). These are 2 straight lines 25 cm. in length 5 cm. apart at one end and 1 cm. apart at the other. The sheet was tacked to a card board and so placed that the wider end of the path was at the child's left, making the line to be drawn from left to right. The experimenter picked up a red pencil saying, "See this pencil? I want you to make a mark right down the path with the pencil. Keep right in the middle of the path all the time. Make it look just like this, a nice straight line." The child was then shown a sample perfectly drawn with a red line down the exact center of the path. When he had completed the line the sheet of paper was turned around so the other path was next to him. Its larger end was at the child's right so that the line had to be drawn from right to left. The instructions were repeated as before.

Negative instructions. This procedure was similar to that above except that instead of showing the child a perfect sample the experimenter showed one very poorly done, pointing out the errors with the words, "Don't touch the sides like this or make a wiggly line like this."

Two methods of scoring were tried. The first score was that part of the guide line, measured in centimeters, where the line that the child had drawn was outside the path. The second method was to measure the total length of the child's line with a map measurer, the score being the length in excess of 25 cm. Neither of these methods proved fine enough to discriminate the effect of suggestion if such existed. The difference between the kind of line drawn under positive and under negative instructions was no greater than the difference between the 2 lines drawn with the same instructions.

2. Coördination test

As a check on the effect of positive and negative instructions, the Johnson form of the Johns Hopkins series of coördination tests (15) was used with the same procedure as the tracing path described above, to the same 43 children. The score consisted of the number of errors, that is, the number of times the child's line touched the side of the path. The results were the exact reverse of what was expected. The average number of errors per sheet was 6.3 under positive instructions, and 3.4 under negative.

3. Ladder experiment

This experiment was an attempt to measure the child's tendency towards involuntary imitation in drawing. Twenty children from 3:6 to 5:4 years of age were tested in groups of five and six. Each child was seated at a separate table and given a sheet of drawing paper on which had been drawn with black crayon 2 parallel vertical lines 20 cm. long and 8 cm. apart. The experimenter had a similar sheet on an easel where it could be plainly seen by the group. She called their attention to it by saying, "Do you see these 2 lines on my paper just like the 2 lines on your paper? I'm going to make a ladder out of these 2 lines by drawing lines straight across. Watch me (drawing). Now you make ladders with these crayons." The children were then given black crayons and the sample left in view while they were drawing. Three methods of drawing the sample were used, making the rungs of the ladder straight across, that is horizontal, or making them slope to the right or to the left so that one edge of each rung was 2 cm. below the other. The test was repeated three times, a week apart, once with each type of suggestion. The results were not significant. Only 6 out of the 20 children accepted the suggestion, that is, made the slope of their rungs pronounced enough to show that it was not the result of chance error.

4. Drawing pictures

This test was similar to the preceding one, but the suggestion was more obvious. The same 20 children were tested in groups as before. Each was given a sheet of paper and 3 colored crayons of his own choice. The experimenter then said, "When I say 'begin' we are all going to draw pictures. You can make any kind of a picture you want to." One of three variations in procedure followed. In one a picture of a flower was shown with the words, "You can make a flower like this if you want to. Look at this flower, with its yellow center and

colored leaves (pointing at the parts and being sure all the children attend). Or you can make anything else you like." In the second type of procedure no picture was shown but the verbal suggestion was given, "You can make a tree if you want, a nice big tree." In the third no suggestion was given.

The individual results were interesting, but quantitatively they have little value because of the small number of subjects. Of the 20 children 5 accepted the suggestion of drawing the tree, 5 of drawing the flower. This test was discarded because it gave only the number of times the suggestion was accepted and not the extent of the acceptance. There were also various sources of error which resulted from the group administration of the test.

5. Running to get ball

This experiment was designed to show the effect of suggestion on the gross bodily activity of the child. The child was placed behind a low gate at one end of an alley 12 feet long and 2 feet wide. At the other end was a low table with a ball on it, well illumined by a drop light. Three types of procedure were used. That with no suggestion was given first. The child was told to go get the ball, the gate was opened, and the time taken to reach the table was recorded. A week later the experiment was repeated with either fast or slow suggestion. The former consisted of the experimenter first demonstrating by running quickly down the alley to get the ball. In giving the slow suggestion she walked very deliberately to the ball. These procedures were alternated for four successive weeks. Finally on the sixth trial as on the first no suggestion was given.

Twenty-nine children from 2:1 to 4:9 years of age were given the test. In two or three individual cases the suggestion seemed to have an effect in slowing down or speeding up the running. But the average time for the group showed no effect of suggestion. There were several sources of error which may account for these negative results. In the first place the suggestion given was not always attended to carefully. The children were distracted by various things, especially the hinge on the gate which they enjoyed manipulating. The timing was not accurate enough for such a short running path. If it had been several times longer the results might have been more satisfactory.

6. Punching, Form A

This experiment was also designed to test the effect of suggestion on speed of movement. A very simple manual process was chosen, that of punching holes in paper. The child was seated at a table on which was placed a sheet of paper with 16 half-inch circles printed on it arranged in the shape of a square. Under the paper was a pad to facilitate the punching of holes. Three types of procedure were used. In one no suggestion was given. The experimenter said, "Take this puncher and make one hole in each circle like this. Make just one hole in every single circle," illustrating by punching 2 holes in a similar sheet with a sharp pointed stylus. The stylus was then handed to the child with the words, "Now you do it." Time was recorded with a

stop watch from the moment of making the first hole to that of making the last. The 2 other procedures were similar except that in one the experimenter punched all the holes first at a rapid rate, taking about 8 seconds, and in the other at a slow rate, taking about 25 to 30 seconds. The experiment was repeated three times each a week apart with a different type of procedure at each sitting. The order of giving the three methods was varied with the different subjects so that the effect of practice would be minimized. Twenty-four children ranging in age from 4:3 to 6:3 took the test.

time. Nor was there a record kept of which hand was employed in punching, sometimes the right and sometimes the left being used. The fact that in spite of these faults in procedure the results were positive, indicated that this test merited further application.

7. Punching, Form B

This modified form attempted to overcome several of the obvious difficulties of Form A. Instead of the 16 half-inch circles printed in the form of a square, 10 were used, placed in a row ½ inch apart on a sheet of paper 4½ by 11 inches in size (fig. 1). The fact that

FIG. 1. PUNCHING SHEET

The results showed a significant difference between the speed of reaction under the various types of suggestion, average time under slow being 25.3 seconds, under fast 20.5 seconds, and under no suggestion, 24.0 seconds. Of the 24 subjects, 19 punched faster under the fast than under the slow suggestion. These results appeared in spite of several sources of error. The arrangement of the circles in the shape of a square resulted in various orders of punching being used. Many of the younger children used no regular order, or varied their method from time to

they were in a straight line did away with the element of order of punching except with the very youngest subjects. The experimenter demonstrated beginning at the child's left and most of the children imitated this method. Another source of error was eliminated in having all the children use the right hand throughout so that there were no variations in this respect from one period to another. To introduce variety and to maintain the children's interest 2 other types of punching sheet were designed. One-half inch squares and triangles were used in

addition to the circles. Few of the children seemed to be affected by this difference. Aside from these changes the procedure was the same as in Form A.

Nineteen children from 3:6 to 5:4 years of age completed this test. The results show a difference of 5.6 seconds in the average time under slow and under fast suggestion: fast, 13.9 seconds; slow, 19.6 seconds; no suggestion, 19.3 seconds. Of the 19 subjects, 16 punched faster under fast suggestion than under slow suggestion.

8. Marking dog

The final test devised was one in which the suggestion was of a more obvious nature than in the preceding experiments, and is more closely akin to imitation as ordinarily conceived. Here again 3 types of procedure were used. These were designated by the letters F, S, and N to correspond with the Fast, Slow, and No suggestion of the punching test.

N procedure (*no suggestion*). A sheet of paper 4½ by 11 inches in size with an outline picture of a dog in the center (fig. 2) was placed in front of the child with the words, "Do you see this doggie? Make a mark on the paper at the side of the doggie." The experimenter then placed a crayon in the child's right hand. When the mark had been made she said, "That's good. Now make a mark on the other side of the doggie." A record was kept of the direction in which the line was drawn.

F procedure (*"far" suggestion*). The picture of the dog was placed in front of the child as before with the words, "Do you see this doggie? I'm going to make a mark on the paper at the side of the doggie." The experimenter then made a vertical line about 1½ centimeters long, 1 centimeter from the right hand margin of the sheet, and half way between the top and bottom margins. The sheet was then removed exposing a similar one beneath it. The experimenter directed, "Now you make a mark on the paper at the side of that doggie," giving the child a crayon. When he had complied she placed the first sheet again before the

FIG. 2. MARKING SHEET, PRELIMINARY TEST

child and repeated, "Now I'm going to make a mark on the other side of the doggie," making a line at the margin of the paper to the left of the dog. This sheet was again removed and the child told, "Now you make a mark on the other side of that doggie."

S procedure (*"short" suggestion*). This was similar to the F procedure except that instead of making the mark at the margin of the paper the experimenter drew it one centimeter from the side of the dog.

The distance of the child's marks from each side of the dog was measured in centimeters and the two added. Twenty-nine children from 2:1 to 4:9 years of age took the test. Several did not complete the series, and 5 of the younger ones merely scribbled, so that the data from only 18 are considered. The subjects were divided into 2 groups equated as nearly as possible on the basis of age and sex. Six test periods were used, at least six days apart. N procedure was used at the first and last of these periods for both groups. One group was tested by the F procedure at the second and fourth periods, and by the S procedure at the third and fifth periods. In the other group this order was reversed.

The results show a marked difference in the average distance of the mark made with the 2 types of example: F procedure, 9.4, centimeters, S procedure, 2.7 centimeters; N procedure, 4.1 centimeters. Of the 18 children, 16 showed greater distance under F than under S suggestion. There were, however, striking individual differences between the reactions of the children. Some totally disregarded the suggestions, others followed them exactly. A third group were erratic in their acceptance or rejection.

The sources of error in this test were the irregularity in outline of the dog, which made the measurement of distance somewhat inaccurate, and the fact that it was not always in the exact center of the page. These two difficulties were eliminated in the final form of the test, used in the major study.

EXPERIMENTAL METHODS

Subjects

The subjects used were drawn from four different sources, 31 from the Child Institute of the Johns Hopkins Psychology Department, 83 from the kindergarten and first grade of two private schools, and 22 from the nursery school of a recreation center. All came from distinctly superior homes except the last group which were from a poor district.

In all 136 children took the tests. The oldest was 7:5, the youngest 1:11 years old. Age is reckoned to the nearest month on the day the first test was given. The subjects were divided into two experimental groups, A and B, and a control group, C. Table 1 shows the age and sex distribution of the subjects completing the two tests.

Schedule of testing

Each child was tested six times with approximately a week between each test. In a few cases this was shortened to six days because of a change in schedule. Absences of the children caused by illness, vacations, and quarantines lengthened the period between tests to more than a week in some cases. Table 2 shows the number of cases in which this occurred. All of the testing took place between the hours of 9 and 11 in the morning.

The three types of procedure were given in a different order to the children in the three groups. No suggestion was used for all of the children in the first and last test periods. Group A was tested with fast or F

suggestion at the second and fourth test periods, and by the slow or S at the third and fifth. In group B this order was reversed. The control group, C, received no suggestion throughout.

TABLE 1

Age and sex distribution of subjects completing tests

The 3 year age group includes those from 2:7 to 3:6 inclusive

	AGE					AVERAGE	BOYS	GIRLS	TOTAL
	3 years	4 years	5 years	6 years	7 years				
Punching Test:									
Group A	1	10	9	13	7	5 years 4 months 29 days	19	21	40
Group B	2	10	12	17	6	5 years 3 months 23 days	24	17	41
Group C	1	4	12	3	0	4 years 10 months 24 days	13	7	20
Total	4	24	32	28	13		56	45	101
Marking Test:									
Group A	2	6	11	13	7	5 years 5 months 13 days	19	20	39
Group B	3	11	15	11	6	5 years 2 months 9 days	27	19	46
Group C	2	5	12	3	0	4 years 4 months 15 days	14	8	22
Total	7	22	38	27	13		64	43	107

TABLE 2

Time intervening between first and last test periods

5– indicates 5 or 5 and a fraction weeks

	5– WEEKS	6– WEEKS	7– WEEKS	8– WEEKS	9– WEEKS	TOTAL
Punching Test:						
Group A	25	11	3	1	0	40
Group B	20	14	6	1	0	41
Group C	4	6	5	4	1	20
Total	49	31	14	6	1	101
Marking Test:						
Group A	20	15	3	1	0	39
Group B	18	18	9	1	0	46
Group C	5	6	6	4	1	22
Total	43	39	18	6	1	107

Punching Test

The procedure in this test was identical with that of the preliminary punching, Form B. The punching form with 10 circles printed in a row was used (fig. 1) with the 3 types of instructions: fast, in which the experimenter demonstrated by punching the 10 holes in 5 seconds; slow, in which they were punched in 20 seconds; and no suggestion, where only two of the holes were punched. A slight variation in method was made for the C

group who were tested without suggestion throughout. After the first test period the experimenter did not punch any of the holes but merely gave the verbal instructions.

The children's behavior in the test situation was interesting. All of them seemed to enjoy this test. Several of those in the first grade remarked upon its being too easy and became rather bored by the sixth trial, but none refused to do what was desired. They were often impatient to start and would say, "I know how," trying to take the stylus before the experimenter had time to complete her demonstration. Sometimes as they watched they would make rhythmic motions in time with her movements, nodding the head or swaying the whole body a little.

There were several unavoidable sources of error in the procedure. One has been mentioned in the problem of the use of the right or left hand. In addition the method of holding the stylus and of punching varied greatly. Some children would punch lightly, making small holes, others very deeply, pushing the stylus completely through the pad to the table top. Another difficulty met with especially in the younger children was irregular order of punching. Finally, several of the children had the tendency to stop and talk during the test. If any of these disturbing elements entered in too marked a degree, timing became inaccurate and the test is classed as not completed. This took place in only 5 subjects above 3 years of age, but in practically all below that age.

Marking Test

The procedure used was identical with that in the preliminary marking test except that a picture of a house (fig. 3) was substituted for that of the dog, and the word "house" used in the instructions in the place of "doggie." On the whole this test did not interest the children as much as the punching. Several asked for a more difficult task. There was a compensating advantage in the simplicity of the reaction since younger children were able to do it successfully than could do the punching. There was one factor introducing error. In several cases a child would

FIG. 3. MARKING SHEET

not wait for the second instruction before making his second mark, thus only one visual suggestion was given instead of the usual two. The results show that this is not as significant as first appears, since the right and left hand marks were in general remarkably symmetrical in their distance from the house.

TREATMENT OF DATA

Group results, Punching Test

The number of seconds taken to punch the ten holes constitutes each

day's score in this test. Table 3 shows the mean scores for each group. Detailed tables giving individual results are in a dissertation on file in the library of the Johns Hopkins University. The influence of suggestion is clearly perceptible in the group averages. For example the scores of Group A fluctuate from 16 to 12 seconds in accordance with the type of suggestion. This difference is made clear by comparing the sum of the two average scores under F suggestion with the sum of the 2 under S suggestion, and also with the scores when no suggestion is given. The last column of table 3 shows this difference and its probable error. As a check the results from Group C, where no suggestion was given, are treated as those in the A Group; that is, the first and sixth trials are classed under N, the second and fourth under F, and the third and fifth under S. This demonstrates clearly that the type of suggestion given had a definite effect upon the children's reactions. In the C Group the difference between the F and S scores is only one-tenth of a second, or .3 per cent of the N reaction, while in the A and B Groups the difference is 6 and 6.4 seconds respectively or 20 and 22 per cent of the N reaction.

The factor of practice effect is one which needs to be considered. If it existed to any large extent it would increase the difference between the F and S reactions in the B Group where the slower suggestion comes first, and decrease this difference in the A Group where the faster comes first. The average punching time in the six consecutive trials of the A and B Groups was as follows: 16.2 seconds, 14.3 seconds, 14.5 seconds, 13.7 seconds, 13.3 seconds, 13.2 seconds. The effect of practice was small except in the first trial where the task was new to the children. This demonstrates the wisdom of giving a preliminary trial to accustom the children to the test situation, even though the reaction required of them may be very simple.

The mean time, of six trials, taken by each child to punch the 10 holes varied from 8 to 25 seconds. Age seemed to have some influence on this general speed of reaction, though not as great difference was found between the 4 and 7 year old reactions as between the F and S. Table 4 gives these

TABLE 3

Mean scores of the three groups

	NUMBER OF CASES	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4	TRIAL 5	TRIAL 6	F	S	N	DIFFERENCE BETWEEN F AND S
Punching Test:											
Group A	40	16.3	12.3	16.3	12.8	14.8	13.9	25.1	31.1	30.2	6.0 ±.69
Group B	41	16.0	16.2	12.6	14.5	11.7	12.5	24.3	30.7	28.4	6.4 ±.84
Group C	20	16.9	16.2	15.5	14.3	14.9	15.1	30.5	30.4	32.0	.1
Marking Test:											
Group A	39	3.2	13.6	2.7	12.8	4.1	4.9	26.4	6.8	8.1	19.6 ±1.35
Group B	46	2.2	1.9	11.1	3.1	11.5	5.2	22.6	4.9	7.4	17.7 ±1.37
Group C	22	1.8	1.6	1.8	1.5	1.4	1.5	3.1	3.2	3.3	.1

results. The smallness of the age groups permits only the generalization that there seems to be a tendency toward greater speed of reaction with increasing age.

Group results, Marking Test

The children's reactions in the Marking Test were scored by measuring in centimeters the horizontal distance from their mark to the side of the house. Variations in type of mark introduced some difficulties. These were eliminated by establishing the rule that the measurement should be made from the point where the child first touched the crayon to paper. In cases where this point was so near the top of the sheet that a horizontal line would strike the roof instead of the side of the house, measurement was made as thought the side extended vertically to the top of the paper.

Daily scores were obtained by adding the distances of the right and left hand marks. This obscures the factor of symmetry between the distances at the right and left sides of the picture. On the whole the children were remarkably consistent in the reactions on the two sides. There was less than 3 centimeters difference between the two in 93 per cent of the cases in the A and B Groups, and in 100 per cent in the C Group.

The influence of suggestion is even more marked than in the Punching Test. Table 3 shows the mean scores of the three groups. It is possible to pick out the trials where F suggestion was given by the large size of the score. The delayed influence of suggestion appears here quite clearly in the sixth score of the A and B Groups which is about twice as large as the first score although both were under no suggestion. In the C Group there was no possibility of delayed suggestion and the first and last scores are practically identical. The sum of the two F, S, and N reactions makes the effect of suggestion even clearer. This also appears in table 3. Here again the results from Group C are treated as those in Group A. The difference between the F and S scores in the C Group is 3 per cent of the N reaction, and in the A and B Groups 41 and 42 per cent respectively.

TABLE 4

Age differences in time scores of the punching test

Means of individual scores given in seconds

	AGE				
	3 years	4 years	5 years	6 years	7 years
Group A	19.1	17.6	14.7	12.1	12.7
Group B	14.2	16.1	13.4	13.2	12.2
Group C	23.1	16.6	15.0	13.4	

Suggestibility scores

From the four daily scores of each child under the F and S suggestion a suggestibility score was computed for

each test. In the Marking Test this consisted of the difference between the sum of the two scores under F suggestion and the sum of the two under S. So if a child drew his mark close to the house when the suggestion was close, and far from it when the suggestion was far, his suggestibility score would be high, denoting positive suggestion. If he paid no attention to the suggestion but marked in the same place throughout, the score would be zero denoting no suggestibility. And finally if he marked near when the suggestion was far, and far when it was near, the score would be a negative quantity, denoting negative suggestibility. There were few of this latter type.

In the Punching Test the simple difference between the scores under F and S suggestion was not an accurate measure of suggestibility because it did not take into account the factor of variations in the speed of punching from child to child. One who was slow in all his reactions would have a proportionally larger difference between those under F and S, and his suggestibility score would be weighted to that degree. The average speed varied from 8 to 25 seconds so this error would be quite large. To overcome the difficulty a ratio was used, since it is relative difference in speed under the two types of suggestion that counts, not absolute difference.

Therefore the suggestibility score in punching is the ratio between the sum of the two daily scores under slow sug-

TABLE 5

Distribution of suggestibility scores in the punching test

Score .60 includes values from .60 through .69

	SCORE																	
	.60	.70	80	.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30
Group A	1	0	2	1	10	5	6	4	2	4	0	2	0	1	1	0	0	1
Group B	1	0	2	3	5	7	3	1	5	2	6	2	2	1	0	1	0	0
Group C	1	0	3	2	9	4	1	0	0	0	0	0	0	0	0	0	0	0
Groups A and B	2	0	4	4	15	12	9	5	7	6	6	4	2	2	1	1	0	1

TABLE 6

Distribution of suggestibility scores in the marking test

Score 4 includes values from 4 through 7.9

	SCORE										
	−4	0	4	8	12	16	20	24	28	32	36
Group A	2	5	2	4	2	2	6	4	4	4	4
Group B	2	11	3	4	3	4	0	2	6	6	5
Group C	6	15	0	0	0	0	0	0	0	0	0
Groups A and B	4	16	5	8	5	6	6	6	10	10	9

gestion and the sum of the two daily scores under fast suggestion. A score above one means positive suggestibility, below one negative suggestibility, and unity means that suggestion has no effect. In comparing the suggestibility scores of the two tests a zero score in Marking is equivalent to a unity score in Punching.

The average suggestibility scores of the 3 groups were as follows: Punching Test, Group A, 1.28 ±.04, Group B 1.33 ±.04, Group C 1.00; Marking Test, Group A 19.6 ±1.35, Group B 17.7 ±1.37, Group C 0.1. The difference in score between the experimental and control groups is quite marked and several times the size of the probable error. The distribution of suggestibility scores, shown in tables 5 and 6 makes this difference even more clear. We see that a large majority of the scores fall above that point denoting no suggestion. There are very few that show negative suggestibility. The distributions of the A and B Groups are quite similar throughout in contrast with the C Group where the scores are closely grouped around the point of no suggestion.

Combining the distributions of the A and B Groups gives an interesting contrast between the two tests (fig. 4). Both have a mode corresponding to the score denoting lack of either positive or negative suggestion. The Punching Test gives a skewed unimodal distribution, with more cases showing positive than negative suggestion. The Marking Test has a bimodal curve, one mode appearing at the point of no suggestibility and a second smaller one at high suggestibility. These two types of curve are similar to those which Estabrooks (9) attributed to emotional and non-emotional situations, and identified with Aveling and Hargreaves' (1) "Prestige and Non-prestige" tests. The U-type of curve supposedly appears when prestige or emotion are present. The factor of prestige certainly entered equally into both Punching and Marking, for the same experimenter demonstrated in both. Nor does emotion appear to be significant. If anything, greater emotion would appear in the Punching Test, which was a more novel situation and a more difficult task, than in the Marking Test, yet the latter has the supposedly emotional type of curve.

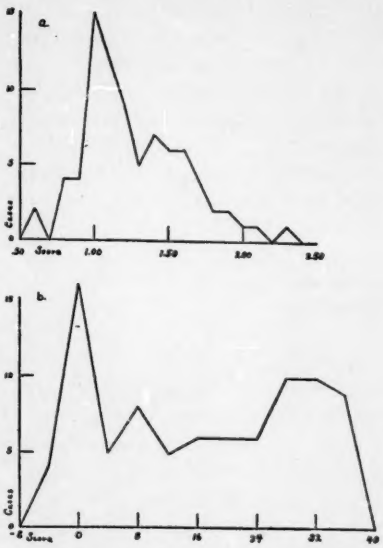

FIG. 4. DISTRIBUTION OF SUGGESTIBILITY SCORES

a, Punching Test; *b*, Marking Test

Two possible explanations of this difference in the distribution of scores are the relative obviousness of the suggestions in the two tests, and the relative ease of following them. Perception of distance is probably a more simple reaction than perception of speed, making the Punching Test suggestion more difficult to follow. In addition the suggestion in the Marking Test was more obvious because it was before the child while he was reacting, while in the Punching Test it was already merely a memory. The second factor accounting for higher suggestibility in the Marking Test is the ease of following the suggestion. Any child could make his mark near or far from the house, but not any child could follow the fast speed of punching. Especially were the younger ones thus handicapped.

Individual reaction curves

An analysis of the curves representing the six consecutive daily reactions of each child reveals many interesting variations. Figures 5 and 6 show typical curves in relation to the suggestions which were given. Since the type of measurement in the two tests was different, the curves resulting cannot be compared directly, and a separate analysis of each is necessary.

Punching Test. It was difficult to classify the individual reaction curves of the Punching Test into types owing to the large number of variations present. In some cases the child's reactions followed those of the experimenter fairly closely, for example figure 5 (*b*), representing the reactions of a child in Group A, is of the same form as figure 5 (*a*), representing the experimenter's reactions in giving the suggestions to that group. Dotted lines connect those points representing reactions where no suggestion was given. Figures 5 (*c*) and (*d*) illustrate the experimenter's and a child's reactions in Group B. Both of these children were highly susceptible to suggestion and received a high suggestibility score. There are cases, however, of children receiving a high score whose curve was not as typical as these.

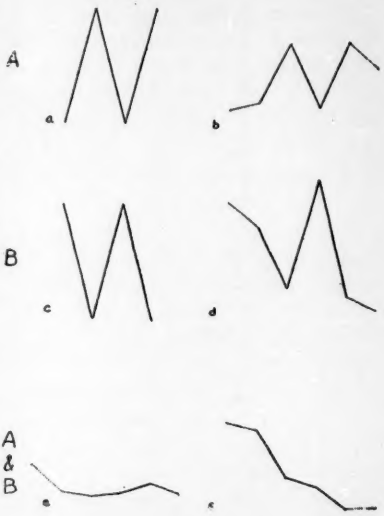

FIG. 5. INDIVIDUAL REACTION CURVES, PUNCHING TEST

a, suggestions given to Group A; *b*, fluctuating curve of Group A; *c*, suggestions given to Group B; *d*, fluctuating curve of Group B; *e*, level curve; *f*, practice curve

In contrast to those curves which demonstrate the effect of suggestion we find some which are fairly level, figure 5 (*e*), and others which are in the form of a typical practice curve, figure

5 (*f*). These two types represent low suggestibility. Each type is not distinct from the others but grades into them by imperceptible degrees. It is necessary to make some arbitrary definition of the limits of each, as follows:

1. Fluctuating Type, more than six seconds difference between the highest and lowest records (fig. 5(*b*) and 5 (*d*)).
2. Level Type, not more than six seconds difference between the highest and lowest records (fig. 5 (*e*)).
3. Practice Type, more than six seconds drop from the first to the last record, and not more than a two second rise at any one point (fig. 5 (*f*)).

The frequency of these types is given in table 7. The distribution in the A and B groups is similar. About two-thirds of the curves are of the fluctuating type. The rest are fairly level. In the C group where no suggestion was given the proportion of irregular curves is lower, being exactly one-half. But even here there were individuals who were as variable in their reactions as some who were given suggestions. In all three groups the number of practice curves is small, showing that the reaction was one so simple that not much improvement occurred. The larger number of curves of this type in Group B is easily explicable, since the order of giving the suggestions, slow then fast, would facilitate the practice effect more than the fast-slow order given to the A Group.

Marking Test. It is possible to distinguish types much more definitely in the Marking Test than in Punching. The following are rather sharply differentiated from each other:

1. "M" Type, in which the reactions follow the suggestions almost exactly, forming an M-shaped curve. Figure 6 (*b*) represents this type of reaction in the A Group following the suggested reactions shown in figure 6 (*a*). Figures 6 (*c*) and 6 (*d*) represent the same for Group B.
2. "V" Type, in which the F suggestion is followed only once, forming a level line with only one pronounced peak, like an inverted V. Figure 6 (*e*) is an example of this type of curve in the B Group. Similar curves occurred in the A Group, with the peak at other points.
3. Delayed Type, in which the F suggestion is effective on trials where it is not given. An example of this curve in the B Group is given in figure 6 (*g*). It occurred also in the A Group.
4. Level Type, where there is no evidence of the effect of suggestion. This is in sharp contrast to all of the other types. Figure 6 (*f*) is an example.

TABLE 7

Distribution of curve types in the punching test

	GROUP A	GROUP B	GROUP C
Fluctuating Type:			
Score above 1.50	9	11	0
Score 1.20 to 1.50	10	8	1
Score below 1.20	7	6	9
Total	26	25	10
Level Type	12	11	7
Practice Type	2	5	3

It occurred in all three groups and is the only type appearing in Group C where no suggestions were given.

5. Irregular, fluctuating and unclassifiable. Only 2 children exhibited this type.

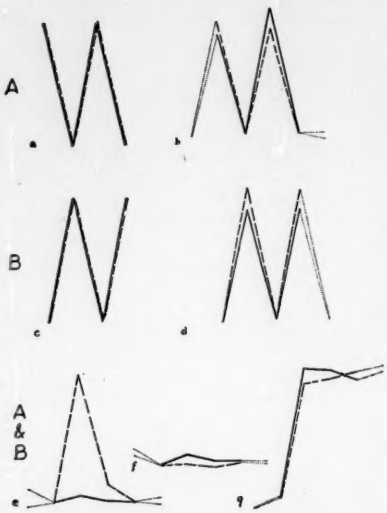

FIG. 6. INDIVIDUAL REACTION CURVES, MARKING TEST

a, suggestions given to Group A; *b*, M Type curve of Group A; *c*, suggestions given to Group B; *d*, M Type curve of Group B; *e*, V Type curve; *f*, level curve; *g*, delayed curve. Unbroken line denotes right side reaction, broken line, left side reactions.

The distribution of each type in the three groups is shown in table 8. Right and left side reactions are both considered and their sum given. Here the contrast of the C Group with the A and B is even more marked than in Punching. Over a third of the children in the first two groups followed the suggestions very closely, and about three-fourths were influenced by them to some extent. The fact, however, that several curves of the level type were found in both the A and B groups indicates that there were some children on whom the suggestion seemed to have absolutely no effect.

The factor of symmetry is illustrated clearly by figure 6. A majority of the individual curves were as those in figure 6 (*b*), (*d*), (*f*), and (*g*), where the right and left side reactions were placed at symmetrical distances from the picture of the house, and are plotted as practically identical curves. There were some cases, however, where the mark on one side was placed near, the other far. Figure 6 (*e*) illustrates one of this type.

The relation which the suggested reactions bear to the children's initial reactions forms an interesting contrast in the 2 tests. In Punching the S suggestion was sometimes faster and sometimes slower than the child's own reaction when no suggestion was given. If it were slower it often produced an inhibitory effect, slowing down the child's speed, as in figure 5 (*b*). If it were faster it would speed up the reaction, as occurred to a slight extent in figure 5 (*d*). The F suggestion was in all cases faster than the child's initial reaction and so produced speeding up when it was effective.

In the Marking Test on the other hand, the F suggestion was the only one which had any effect in changing the children's reaction. In practically all cases the S suggestion coincided very closely with the child's own reaction when no suggestion was given. Figure 6 illustrates this clearly. All of the initial reactions in the children's curves are near the S distance. This

fact seems to be responsible for the larger number of cases of level curves in the B than in the A Group. In the former the S suggestion was given first. Being similar to the child's own reaction, this suggestion reinforced it and made him impervious to the later F suggestions. In the A Group the F came first and not having so much resistance to overcome was more successful in producing acceptance, so the number of M type curves is larger than in Group B.

The difference between the F and S suggestions was more definite in Marking than in Punching. This may account for the higher suggestibility in Marking and for the fact that the curve types are more distinct here.

TABLE 8

Distribution of curve types in the marking test

	GROUP A	GROUP B	GROUP C
M Type	35	28	0
V Type	17	15	0
Delayed Type	10	17	0
Level Type	14	30	40
Irregular Type	2	2	0

Consistency

The problem of an individual's consistency in his acceptance of suggestion is one which has received much consideration. In general the results of previous experimentation indicate that suggestibility is not a persistent trait of personality, but is related to the specific situation. The findings of this study uphold these conclusions.

There were several methods of studying how consistent the children were in their suggestibility. One method was that ordinarily used in measuring reliability. The tests were divided in two parts and the halves correlated. In Marking this was done by finding the difference between the daily score under F and S suggestion in the second and third daily periods, and the difference in the fourth and fifth. These two scores were then correlated. The coefficients obtained were not high but of some significance, indicating that a child who followed the suggestions in the first part of the experiment was likely to do so in the latter half. They were for the A group .40 $\pm$.08,* and for the B group .55 $\pm$.07.

Fourteen of the children had been given the Marking Test before in practically identical form, Marking Dog. They formed a group whose consistency could be measured in another way. This was done by correlating the suggestibility scores on the two tests. The coefficient here was again positive, .35, $\pm$.16, but the smallness of the group made the probable error so large that it cannot be considered significant.

Consistency of reaction on the Punching Test was studied in the same way as Marking. A ratio between the first two F and S reactions was com-

* All correlations were computed by the rank order method using Pearsons "Rho" Formula.

puted, similar to the suggestibility score for the whole test, and this was correlated with a ratio obtained from the last two F and S scores. Here the coefficients obtained, though positive, were very low and cannot be considered significant. They were in the A Group .10 ±.29 in the B Group .30 ±.17. From this we infer that the children more suggestible in one part of the Punching Test are not especially likely to be so in the other.

A final method of measuring consistency of response to suggestive stimuli consisted in correlating the scores of the two tests, Punching and Marking. Here again the coefficient was low with a large probable error, .12 ±.11. We must therefore conclude that suggestibility as here measured is not a persistent trait but one which varies greatly from situation to situation and from time to time in the same situation.

Age and sex differences

The influence of age on suggestibility score is different in the two tests. In punching there is a positive correlation represented by the coefficient .47 ±.09. This relationship is shown in table 9 which gives the average score for the various age groups. The C group indicates that where no suggestion is present the score does not vary with age. We may therefore conclude that in this test the older children are more suggestible. This is not true in the Marking Test. The coefficient of correlation between age and suggestibility score is not significant, being .25 ±.10. The average scores for the different ages, shown in table 9, indicates this slight tendency towards decreasing score with decreasing age.

TABLE 9

Age differences in mean suggestibility scores

	AGE				
	3 years	4 years	5 years	6 years	7 years
Punching Test:					
Group A	1.02	1.24	1.22	1.33	1.36
Group B	1.10	1.05	1.30	1.53	1.59
Group C	.91	1.03	1.01	.97	
Marking Test:					
Group A	12.0	17.5	14.1	22.8	26.4
Group B	9.4	17.9	17.2	20.2	17.9
Group C	−3.1	.4	.2	−.3	

The factor of relative difficulty of the two tests may again be used in explanation of this difference between them. The Marking Test would indicate that four year old children are as susceptible to suggestion as those of six and seven, when they can comprehend it and are able to carry it out. In the Punching Test their lack of manual dexterity and perhaps the fact that they do not easily perceive the sugges-

tion, speed of movement, makes them less suggestible than those somewhat older.

No significant sex differences were found. In the Punching Test the difference in score between the boys and girls was in Group A .13 ±.07, in Group B .08 ±.07, the girls being slightly more suggestible. In the Marking Test the boys were more suggestible in Group A by a difference of .9 and the girls in Group B by a difference of 3.4.

SUMMARY

Varying types of experimental situations were used in an endeavor to select some which would give a measure of a child's response to suggestive stimuli. Two coördination tests given with positive and negative instructions gave indications that the negative instructions produced no perceptible effect. Two tests involving drawing were not continued because they measured only acceptance or non-acceptance of suggestion and not the extent of each. A test in which gross bodily movements were involved proved unsatisfactory because of the length of time required for response and the possibility of distraction of the child's attention by other factors.

Two tests were finally adopted for a more extensive study in which visual stimuli acted as suggestions influencing simple hand movements. Measurements of the reactions of 101 children from 3 to 7 years of age under two opposing types of suggestion showed a definite effect which a control group of 35 children, who were given no suggestions, did not exhibit.

Several conclusions regarding suggestibility may be drawn from the results of this study.

1. Most children are suggestible to a certain degree in one situation or another, although a few appear to be uninfluenced by visual suggestion of the type used. In some suggestion has a delayed effect. Negative suggestibility is rare.

2. Suggestions of two opposing types are accepted successively when a time interval occurs between their presentation. Suggestions which are similar to a child's own method of reaction reinforce his tendency and make opposing suggestions less effective.

3. The extent to which suggestion is followed depends on the obviousness of the suggestion and the ease of performing the movements which it involves.

4. Children are not consistent in their acceptance or rejection of suggestion. In repetition of identical situations there is some probability that they will react in the same way, but this is not true if a time interval of more than a few weeks intervenes. Individual suggestibility in one type of situation seems to bear no relation to that in another.

5. Suggestibility increases slightly with age in the age range here considered. No sex differences are apparent.

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The Anatomical Features of Epiphysial Union[1]

T. Wingate Todd

Modern investigation of epiphysial union

SEVEN years ago when we first began to have doubts concerning the reliability of the time tables of epiphysial union contained in anatomical texts, I requested Stevenson to make a careful study of the various standard descriptions with a view to tracing their origin. A bare summary of his results is given in a paper published by him at that time. Internal evidence points to all modern textbook accounts having been derived directly or indirectly from the account by Henle in the middle of last century (6). Apparently Henle had some adolescent skeletons upon which to base his description. Since then minor changes have been introduced into Henle's account though most of the modifications have been made upon what, in the light of our evidence, is clearly untrustworthy observation. Dwight alone had material which permitted him to feel at liberty to make quite bold and definite alterations in Henle's schedule. This induced me to attempt a survey of all skeletons of known individuals and exact age from the bodies of children and adolescents housed in the anatomical laboratories of the United States, Canada and Great Britain. I hoped in this manner to amplify the observations made on our own collection which then numbered over one hundred and now exceeds two hundred. The answers to my letters were most unsatisfactory and disclosed, in the three countries, only 5 skeletons for which the age could be given with any close degree of approximation. This extraordinary state of affairs should be borne in mind in considering the evidence which we present from the comparatively rich collection in Cleveland. And it should be particularly remembered in weighing the adverse criticism of others who have reproached us from time to time for the temerity with which we have ventured to question current teaching.

The object of this paper is to set forth the facts of epiphysial union as seen on the actual bones and on roentgenograms of them. Our observations have a definiteness and assurance which can only arise from the advantage of examining in detail the very bones roentgenographed. However voluminous the data gathered from roentgenograms not so con-

[1] This is the second of a series of studies on Comparative Youth from the Hamann Museum, Laboratory of Anatomy, Western Reserve University, Cleveland, Ohio, prepared for the White House Conference.

trolled, the total result is almost worthless because the investigators have had no opportunity of testing their interpretations of the roentgenograms. In making such a statement the reader who may be amazed at its drastic character, should remember that I refer to the large or deeply placed diaphyso-epiphysial sites only. In elbow, wrist and ankle, but still more in shoulder, knee and hip the overlapping roentgenographic shadows and the obscuration of outline by the overlying soft tissues render interpretation of roentgenograms most hazardous without a course of careful training in comparison of roentgenogram with naked bones. Most of those who have felt impelled to challenge the observations published by Stevenson under my direction have relied upon their ability to read a roentgenogram without this controlling dissection (7, 8, 9, 10, 17). One author has utilized mammalian material which he has indeed dissected (1) but has later gracefully acknowledged (2) after consultation to have been anomolous in that it shows what I have described as lapsed union (13). Another (4) has based his objection on very inadequate observation of a few mammalian skeletons. His findings are of no account when set beside the comprehensive survey of over a thousand mammalian skeletons which I have investigated for this purpose.

Stevenson's investigation was confined to the long limb bones excluding hand and foot, to the scapulae, ribs and ossa innominata (11). Later D'Errico extended the inquiry, also under my direction, to the clavicles (14). These researches are but a small part of the vigorous and comprehensive survey which I have personally undertaken of all epiphyses of the mammalia including man and have prosecuted continuously for the last eight years as a part of the investigation of age changes in skeletons. The survey completed to date covers more than three thousand human skeletons of which eighteen hundred are those of known individuals whose age is ascertained. These are in the collection at Western Reserve University. Twelve hundred are drawn from archeological investigations in New Mexico and Arizona. These skeletons are now housed in the American Museum of Natural History and in the Peabody Museum of Harvard University. For the opportunity to examine them I am indebted to Doctor Clark Wissler, Doctor E. A. Hooton and Doctor A. V. Kidder. The remainder are of miscellaneous origin both in place and time. They include the Scarborough series and others now in the collection at the Royal College of Surgeons which were kindly placed at my disposal by Sir Arthur Keith.

The mammalian skeletons numbering upwards of one thousand including one hundred and fifty anthropoids, comprise the collections in the Hamann Museum of Western Reserve University gathered together by myself for investigations on growth, in the Royal College of Surgeons, the American Museum of Natural History, the National Museum at Washington and the Field Museum in Chicago.

Publication of our findings has been purposely delayed, in spite of incitement to reply to adverse criticism, for two reasons. First the more deeply

we progressed into the subject the more complex it grew and the greater the number of problems which arose out of it. Until we were able to make an adequate comparison of skeletal maturation in man with that of other mammals I felt a lack of fundamental knowledge. This has now been obtained and an initial statement of our findings has gone to press under the title Comparative Youth (15). Secondly I desired, before publication, to put our observations to the intensely pragmatic test of clinical application. Having now had the opportunity of thoroughly investigating skeletal maturation on over one thousand living children whom we have examined roentgenographically at intervals of several months up to two years, and on the latest of which we have also had the confirming evidence of psychological tests, I feel free to set forth our results in detail with confidence.

The reason why Stevenson found such striking uniformity in order of epiphysial union is that this order is a feature of mammalian development in general. There are exceptions, ordinal and generic divergences, but fundamentally and essentially the order-pattern is mammalian in extent. The reason why Stevenson found so close a time-relationship is that the period eighteen to twenty-two human years is that of most stable and uniform human maturation in both sexes and in both white and negro stocks. The reason why our investigations of epiphysial union during these early adult years bear results differing fundamentally from those of other workers is that we alone have had the opportunity of checking our roentgenographic observations upon the actual bones roentgenographed and that we alone have had at our disposal criteria establishing the normal or pathological character of the diaphyso-epiphysial site.

In this paper I propose to set forth the results of our observations upon actual epiphysial union and its exhibition in roentgenograms.

THE PROGRESS OF EPIPHYSIAL MATURATION AND UNION

It has already been stated that previous to our investigations Dwight (3) is the only modern anatomist who has had the necessary material upon which to base an original study of epiphysial union. I have been unable to unearth the material upon which these investigations were made but our experience confirms Dwight's conclusions on limb bones, barring hand and foot, in practically every respect. For an adequate understanding, however, of the process of epiphysial union it is necessary to make a more detailed examination.

The sites where the successive stages can be most easily followed and, indeed, can be identified on the roentgenogram if the actual bones are not available, are the lower end of radius and distal extremity of the humerus. In the description which follows the reader will understand that, though adequate handling of the subject requires a knowledge extending beyond these two areas it is on these that the reader, with material or roentgenograms at his disposal, will most conveniently be able to follow our description.

An epiphysis is often loosely thought of as a bony cap to the shaft. It is not. It is a cartilaginous cap which eventually ossifies completely, in part, or not at all. Whether the epiphysis ossifies or not, the adjacent area of the shaft goes through identical stages of progress. If the epiphysis does ossify it also goes through the same stages. Lower epiphysis of radius and capitulum of humerus do ossify completely. It is only in the latest stages when overlapping shadows may confuse their roentgenographic picture. They may therefore be relied upon, almost to the conclusion of union, to give confirmation of our description. The approximate age relationships are given for males. Reference will rarely be made to females in order to avoid confusion and excessive length of discussion.

There first appears that early stage when the ossification in the epiphysis is nothing more than a nodule of approximately spherical form and the adjacent area of the bony shaft is similarly devoid of characteristic shape.

This is followed by progressive ossification of the epiphysis which in its bony outline comes to reproduce more and more accurately the outline of the growing cartilaginous epiphysis. At the same time ossification continues in the shaft. As a result the adjacent surfaces of epiphysis and shaft are reproduced in reciprocal outline of cancellous bone. There is no condensation of the surface even into the thinnest layer of compacta. When the structures are macerated at this stage the cancellous character of the surfaces is plainly apparent to the naked eye. They are friable and easily damaged.

The considerable interval between shaft and epiphysial surface characteristic of this stage is maintained until shortly before union takes place.

The second stage is a change in the bone texture adjacent to the delimiting surface both on shaft and epiphysis. This is apparent on the roentgenogram as a hazy ribbon involving the bony surface and extending deeply from it into the bony substance to a depth, on the shaft side, of approximately three millimeters, less on the epiphysial side. Exactly what happens to produce this appearance will doubtless eventually be determined by histological research. We do know that an oedema produces a like result and the area can be picked out and distinguished from the rest of the bony by differential staining by toluidin. Coincident with this appearance which occurs in the knee at approximately seven years there is a temporary pause in growth. In the knee this stage lasts six to twelve months. A similar appearance may supervene during and shortly after one of the exanthemata or other toxic condition. It remains a variable time after such origination as fine white scar.

The third stage is a progressive clearing of this haziness. As the bony outlines again become clear they possess a thin coating of more condensed osseous tissue which is identifiable on the roentgenogram as a fine delimiting line of bone at the adjacent surfaces of shaft and epiphysis. The duration of this stage varies and we do not yet know its time limits for the several sites.

Following upon the definition of the bony surface the fourth stage supervenes. This is the stage of billowing which is of considerable duration. I have described it in detail for the symphysis pubis (12) where it lasts almost throughout the second decade. It is first seen in the roentgenogram of the lower end of the radius at about seven years and a half, on the capitular surface of humeral shaft at about five years and on the olecranon six months later. A similar billowing can be seen on the surface of the bone of the developing femoral condyles and trochlear surface between five and six years. In this location I have known it sometimes mistaken for commencing tuberculosis.

The billowing is most regular and easily seen roentgenographically at the symphysis pubis but once the reader has found it there he will readily identify it elsewhere. I have given a full description of its appearance on the pubic bone in my earlier studies already mentioned and in a recent record of our roentgenographic observations (16).

The fifth stage is the stabilization of parallelism in diaphysial and epiphysial bony outline. It occurs in the male diaphysoepiphysial area for the humeral capitulum at about eleven and a half years though its occurrence may be as much as two years earlier in the female. At this site then the lateral roentgenogram shows a definite parallelism in the clear white billowy outlines of adjacent surfaces on shaft and epiphysis.

Shortly after Stevenson's observations had been published Hellman got the opportunity to study epiphysial union in the hand. Stage V as just described corresponds to Hellman's stage A (5).

Our stage VI, which corresponds to Hellman's stage B, supervenes at a date varying with the site but always later than the appearance of stage V. It is characterised by a narrowing of the gap between the parallel lines of shaft and epiphysial surfaces. At the capitulum it occurs at about thirteen years in the male, about a year earlier in the female. The definite white outline of surface is retained and ossification is completed characteristically into all remaining crannies of the outline. This final extension of ossification may fail as, for example, on the dorsal surface of the olecranon or just below the tibial tubercle but such imperfections are of no real significance. The cartilaginous pocket may be transformed into bone later

In the following stage, No. VII, corresponding to Hellman's stage C, there is a definite breaking up of adjacent outlines on the roentgenogram with patchy loss of the delimiting white line and extensions of bone across the intervening gap between shaft and epiphysis. This is the stage of commencing union. On actual dissection one finds that union always begins in the deeper parts of the diaphyso-epiphysial areas and extends erratically to the outer surface of the bone. Hence, so long as, to the naked eye, there is a gap, however narrow or restricted in extent, union has not been perfected. When the macerated or dissected bone no longer shows surface discontinuity one may be sure that union is completed.

In large diaphyso-epiphysial sites,

like the knee and femoral trochanters where there is much interdigitation of shaft and epiphysis, or in sites of extensive overlap like the upper ends of humerus and femur, the confusing medley of shadows on the roentgenogram actually obscures the precise relationship of shaft and epiphysis. The depth of soft tissues in all these areas adds to the difficulty of determination. For knee and shoulder stereoscopic roentgenograms are of some help though even with their aid judgment may be quite fallacious unless the investigator has trained himself very carefully by control observations on the bones by dissection and maceration after roentgenography. The record of the observations itself carries intrinsic evidence of its reliability or its worthlessness.

The reason for Hellman's conclusion that sometimes, in the phalanges, his stage B or C or both may be omitted is this very overlap of shadows. There is no doubt however that, in small areas like the phalangeal sites, Hellman's stages B, C, D may follow each other quite rapidly. Our corresponding stages VI, VII, VIII go through their gamut with astonishing speed at the outer end of the clavicle. At this site their sequence is so rapid and follows so fast upon ossification in the epiphysial cartilage that a lateral epiphysis to the clavicle finds no place in current descriptions of the skeleton. This was shown in great detail by D'Errico and myself (14).

Stage VIII, Hellman's stage D, is the early stage of complete epiphysial union. To the naked eye the diaphyso-epiphysial line of union shows on the outer surface of the bone as a thin red line. On the roentgenogram it is identified by a thicker single white line in place of the patchy irregularity with isolated areas of double fine lines paralleling each other on or between the patchy areas. On ankle, elbow and wrist it can be distinguished with difficulty from stage VII and I prefer myself to make no final judgment in most roentgenograms where stages VII to IX are in question. In knee, hip and shoulder it is distinguished with even greater difficulty and one may be quite uncertain of any stage between VI and IX inclusive.

The white line of the roentgenogram, characteristic of stage VIII, persists as a fine scar for some months. It may remain throughout life as it often does in the upper tibia, or it may disappear after about six months as it almost always does in lower ulna and, somewhat less often, in lower radius. We have defined this stage as recent union.

Stage IX, Hellman's stage E, is that of perfected union with continuity of the osseous trabeculae from shaft to epiphysis. When this stage supervenes all trace of epiphysial differentiation is lost.

THE AGE-ORDER OF EPIPHYSIAL UNION

Before closing this article we shall set forth in tabular form the age-order of epiphysial union as it occurs in human beings of both sexes and in sound condition (table 1). It must be remembered that all dates are subject to minor modification though the mass of our observations is already so huge that I doubt if much alteration will be necessary. There is an individual variation of which Hellman calculated the standard deviation as

three months, thus providing a normal limit of nine months on each side of the mean date. This accords with our observations. Further, in the absence of a birth certificate or at least the exact date of birth, a given age may refer to any date during the eighteen months which intervene between the birthday next above and half way towards the birthday next below. Our experience is that children of good physical grade usually present epiphysial stages in the upper nine months. We do not regard a child as retarded unless his skeletal maturation falls beyond the limit of the lower nine months.

IRREGULARITIES OF SKELETAL MATURATION

We do occasionally find children exhibiting a general acceleration of skeletal maturation and, far more rarely we find local accelerations. There is some correlation between stature and skeletal maturation of the knee. There is a rare local acceleration observed in hand only.

Far more often retardation is exhibited in skeletal maturation. It takes three forms.

1. General retardation or repression.
2. Local inhibition or lapsed union.
3. Temporary repression with irregular recovery.

In rare instances of pronounced pathological character we meet with total inhibition or general lapsed union. In such patients the age at which inhibition occurred can be definitely ascertained by a study of the roentgenograms.

This is not the place for a description of irregularities: they must be dealt with fully in later communications. They do however suggest that the entire pattern of skeletal maturation is under definite control and that deviations from the schedule of table 1, definitely identifiable, may be due to disorganization of, or interference, however slight, with this control.

TABLE 1

Age order of epiphysial union in man, partial list: identifiable roentgenographically

SKELETAL SITE	USUAL LIMITS OF UNION	
	Male	Female
	years	*years*
Humerus distal	14.0–15.0	12.5–13.5
Calcaneus	14.5–15.5	13.0–14.0
Foot 2nd and 3rd phal.	14.0–15.0	12.5–13.5
Foot 1st phal.	14.5–15.5	13.0–14.0
Ulna proximal	14.5–15.5	12.5–13.5
Hand 3rd phal.	14.5–15.5	13.0–14.0
Radius head	14.5–15.5	12.5–13.5
Humerus med. ep.	15.0–16.0	13.5–14.5
Os innom primary elements	15.0–16.0	13.0–14.0
Hand 1st phal.	15.0–16.0	14.0–15.0
Hand 2nd phal.	15.0–16.0	14.5–15.5
Metatarsals.	15.0–16.0	14.0–15.0
Metacarpals.	15.5–16.5	15.0–16.0
Tib. fib. distal*	15.5–16.5	14.5–15.5
Femoral head	17.0–18.0	17.0–18.0
Trochanters	17.0–18.0	17.0–18.0
Isch. tuber	17.0–18.0	17.0–18.0
Tib. fib. prox.	17.5–18.5	17.5–18.5
Femur dist.	17.5–18.5	17.5–18.5
Radius, ulna dist.	18.0–19.0	18.0–19.0
Acromion	18.0–19.0	18.0–19.0
Clavicle lateral	19.0–20.0	19.0–20.0
Humerus prox.	19.5–20.5	19.5–20.5
Scapula lower angle	20.0–21.0	20.0–21.0
Scapula vert. border	20.0–21.0	20.0–21.0
Iliac crest	20.0–21.0	20.0–21.0
Clavicle sternal end	25.0–28.0	25.0–28.0

The complete list of epiphysial fusions will be given in a later communication. Many can be identified upon the skeleton only.

* May be revised.

SUMMARY

1. The general review of observations here recorded is part of our investigation of skeletal maturation and age changes. It has been carried out on over 3000 human skeletons of which 1800 were from known individuals of ascertained age. The investigations on skeletal maturation in childhood and youth cover 200 of the known skeletons. They also include over 1000 mammalian skeletons and a roentgenographic study of over 1000 children.

2. The progress of epiphysial maturation and union can readily be subdivided into nine stages.

The first extends to the period when diaphysial and epiphysial bone approximate each other but as yet show no intimate relation, the adjacent surfaces being ill-defined and composed of cancellous tissue.

The second is the stage of obscuration of the adjacent bony surfaces by their transformation into thick hazy zones.

The third stage shows clearing of the haze with appearance of a fine delimiting surface of more condensed tissue shown on the roentgenogram as a fine white line.

The fourth stage exhibits billowing of adjacent surfaces.

In the fifth the adjacent surfaces show reciprocal outlines which are parallel to each other.

In the sixth the gap between adjacent surfaces is narrowed.

The seventh is the stage of commencing union when the fine white billowed outlines break up.

In the eighth stage union is complete though recent and appears on the naked bone as a fine red line.

The ninth stage is that of perfected union with continuity of trabeculae from shaft to epiphysis.

3. The age order of union is perfectly definite in sound healthy human beings and a partial list of epiphysial unions with their dates is given. Those selected are of greatest service in checking maturation in relation to age.

4. The problem of irregularities in date of union is briefly reviewed but complete presentation of this subject is deferred for later consideration.

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The Learning of Abstract Concepts of Size[1]

J. Allan Hicks and Florence D. Stewart

IN THIS experiment children two to five years of age were tested on their ability to learn to select the middle-size of 3 boxes. Six boxes varying proportionately in size were used to make up 4 series of 3 boxes each. Each series was presented in such order that after a child had learned to select the middle-size box in one group he was shown a new combination from which the "largest" box of the previous series had been dropped and a new "smallest" box added. This procedure made it possible to study the ability of children to apply the concept of size. If a child continued to select a box after it had become the largest rather than the middle-size box in a new series it indicated that he was selecting a particular box independent of its relation to the other 2 boxes. On the other hand, if he selected the middle-size box in a new series and ignored the box which he had been selecting in the former series, it indicated he was utilizing the concept of "middle-sizeness" independently of a particular box.

Forty children were studied—10 two-year-olds, 10 three-year-olds, 10 four-year-olds and 10 five-year-olds. Twenty children were attending the nursery school section of the Washington Child Research Center and 20 the pre-kindergarten and kindergarten classes of the John Quincy Adams School of the public school system of Washington, D. C. All the children are from homes in one of the better residential districts of Washington in which the cultural advantages are above average.

[1] This study was made at the Washington Child Research Center.

DESCRIPTION OF TEST

The 6 boxes used in this experiment were cubes open on one side. They varied proportionately in size from the largest box, with sides 14 centimeters long, to the smallest box with sides 4 centimeters long (fig. 1). All of the boxes were covered with red paper and were identical except in size.

A small toy was always placed under the middle-size box in order to help motivate its selection and to identify the correct response to the child. This procedure also served to make the experiment an interesting "game" for the child.

For clearness in discussion the boxes are indicated according to size by numbers ranging from 1 to 6, the largest box being number 1 and the smallest number 6. They were pre-

sented to each child in 4 series (fig. 1) of 3 boxes each in the following order:

POSITION	SERIES 1			SERIES 2			SERIES 3			SERIES 4		
a...	**2**	1	3	2	4	**3**	3	4	5	**5**	6	4
b...	1	3	**2**	4	**3**	2	**4**	5	3	4	**5**	6
c...	3	**2**	1	**3**	2	4	5	3	**4**	6	4	**5**

The number to the left in each of the above positions represents the box which was on the child's right as he faced the table. The boldfaced number in each case was the middle-size box in the particular series in which it was presented. By varying the position of the boxes during each series the factor of position as a possible basis of learning was eliminated. During a single practice period the 3 positions of a series were repeated 5 times in the order given. Thus 15 trials or choices were made by a child in the course of each practice period.

Each series was presented until the child made a perfect record on the 15 trials constituting a practice period. The next series was presented at the following practice period. If at the end of the sixth practice period or after 90 trials on the first series the child was not getting more than one-third of the responses correct he was deemed unable to learn to discriminate among the boxes and training was discontinued. The interval between practice periods was never less than one day nor more than three. Any subjects who were absent more than three consecutive days and could not be tested in their homes, were dropped from the experiment.

While arranging the boxes in position on the table approximately three inches apart the examiner concealed them from the child's view with a screen.

For the first trial on series 1 the boxes were presented to the child in position (a) in the following manner:

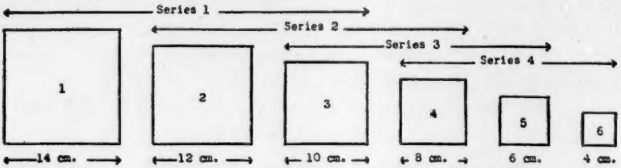

FIG. 1. SERIES OF BOXES IN SIZE RELATIONSHIP TEST

Pronouncing middle-size as nearly as possible as a unit with equal emphasis on both parts, the examiner said: "Now we are going to play a new game. Here is a middle-size box (pointing), a big box (pointing) and a tiny box (pointing). There is a toy under the middle-size box but there is nothing under the big box or the tiny box (lifting each box to demonstrate). Remember, the toy is always under the middle-size box."

The examiner placed the screen before the boxes and rearranged them in order 1 3 2 (position (b) in series 1). "Here is the big box (pointing), the tiny box (pointing) and the middle-

size box (pointing). And remember, the toy is always under the middle-size box." (Pause.) If the child indicated the wrong box, the examiner said: "No, that is the ———— box. The toy is always under the middle-size box (raising box)." If the correct box was indicated the examiner said, "Yes, the toy is always under the middle-size box."

"Now let us do it together once more before you do it alone." The boxes were arranged behind the screen in order 3 2 1 (position (c) in series 1). Pointing to the smallest box, the examiner said, "Here is—(pausing for response)." If the child did not respond immediately, the examiner completed the sentence, "—the tiny box." The same procedure was followed with the other boxes, the examiner pausing each time to give the child an opportunity to identify the box indicated. The examiner then continued: "Remember, the toy is always under the middle-size box. All right, find the toy for me." The subject was given time to indicate the box and the examiner commented upon his choice: "That is right" or, "No, that is the ————box, the toy is always under the middle-size box," (raising the middle-size box).

Following this demonstration the examiner began the test proper. The boxes were presented in position (a) of series 1 (2 1 3) with the instructions, "Now I want you to do it all by yourself and find the toy the very first time you try. Are you all ready? Remember, the toy is always under the middle-size box." After the child had made his choice, the examiner said: "That is right" or, "No, it's always under the middle-size box" (raising the middle-size box).

After rearranging the boxes and before the child attempted to select the middle-size box in the new position, the examiner called his attention to the problem by saying: "Remember, the toys is always under the middle-size box." This language is the same as in the initial instructions and was used without variation with each new position throughout the test. The comment upon the child's choice was exactly the same as at the end of the first trial. If he made a second or third choice spontaneously his action was recorded. If he failed and did not make another choice the examiner raised the middle-size box saying: "It's always under the middle-size box."

Before beginning the test on succeeding days the examiner said: "Do you remember how we played our game? The toy was always under the middle-size box. All right, find the toy for me."

A record was kept on a suitable blank form of the number of the box chosen, the hand used in the choice and the general reaction of a child to the test.

RESULTS

The performance of each child on the size relationship test is summarized in table 1 for each series and for all series combined. This table shows the number of practice periods required to learn to select the middle-size box without error on the 15 choices required on each practice period and the number of errors or wrong choices made.

TABLE 1

Number of practice periods and number of errors for individuals on the size relationship test

CHILD	AGE	SERIES 1		2		3		4		TOTAL	
		Practice periods	Errors	Practice periods	Errors	Practice periods	Errors	Practice periods	Errors	Practice periods	Errors
				Two-year-olds							
	months										
BR	23	6	62								
HD	23	6	64								
EC	26	6	57								
BK	27	6	60								
MD	27	6	52								
BP	27	6	54								
DP	28	6	61								
JV	28	6	60								
BB	28	3	9	3	7	2	2	1	0	9	18
BL	29	6	62								
Av.	26.6	5.7	54.1								
				Three-year-olds							
CW	30	7	51	1	0	2	2	2	1	12	54
PF	33	4	8	1	0	2	1	1	0	8	9
DM	34	1	0	1	0	2	2	2	2	6	4
WH	36	6	37	2	1	1	0	1	0	10	38
AD	37	2	7	2	1	2	3	1	0	7	11
AL	37	4	12	2	4	1	0	1	0	8	16
CS	38	2	1	2	1	1	0	1	0	6	2
JC	40	1	0	3	11	1	0	1	0	6	11
HG	41	1	0	2	1	3	8	1	0	7	9
BD	42	2	2	2	1	2	1	1	0	7	4
Av.	36.8	3.0	11.8	1.8	2.0	1.7	1.7	1.2	0.3	7.7	15.8
				Four-year-olds							
ME	43	5	16	1	0	1	0	1	0	8	16
RH	44	2	1	2	1	1	0	1	0	6	2
DD	44	2	6	1	0	1	0	2	1	6	7
NS	46	1	0	3	5	1	0	1	0	6	5
RE	49	1	0	1	0	1	0	1	0	4	0
BL	50	1	0	2	1	2	2	1	0	6	3
PS	51	2	5	2	1	2	2	2	3	8	11
RP	51	1	0	1	0	2	3	3	4	7	7
JH	51	2	1	1	0	1	0	1	0	5	1
FE	52	1	0	1	0	1	0	1	0	4	0
Av.	48.1	1.8	2.9	1.5	0.8	1.3	0.7	1.4	0.8	6.0	5.2

TABLE 1—*Concluded*

CHILD	AGE	SERIES 1		2		3		4		TOTAL	
		Practice periods	Errors	Practice periods	Errors	Practice periods	Errors	Practice periods	Errors	Practice periods	Errors
Five-year-olds											
	months										
BH	56	1	0	1	0	2	1	2	1	6	2
GG	60	1	0	1	0	1	0	2	1	5	1
AW	60	2	1	1	0	1	0	1	0	5	1
MK	61	2	2	1	0	1	0	2	1	6	3
BV	62	1	0	1	0	1	0	1	0	4	0
GD	63	1	0	1	0	1	0	2	1	5	1
BM	64	3	10	2	1	1	0	1	0	7	11
DL	64	1	0	1	0	1	0	1	0	4	0
NT	64	1	0	1	0	1	0	1	0	4	0
BR	65	1	0	1	0	1	0	1	0	4	0
Av	61.9	1.4	1.3	1.1	0.1	1.1	0.1	1.4	0.4	5.0	1.9

Age factor

Table 1 shows that the older children took fewer practice periods to learn the 4 series and made fewer errors in selecting the middle-size box. With one exception the two-year-olds failed to learn the first series and were dropped after 6 trials according to the arbitrary standard previously described. For series 1 the 10 children in this group made 541 errors. All of the three, four and five-year olds learned the 4 series. For these children table 2 gives the number of practice periods, the number of errors, the means, the medians, and the ranges for the 4 series combined.

Table 2 brings out the fact that the number of practice periods, the number of errors, the means, the medians, and the ranges consistently decrease in size with the older children thus indicating marked age differences.

The correlation between chronological age and practice periods for the 30 children, ages three to five inclusive, was $-.68 \pm .07$. The correlation between chronological age and number of errors for the same children was $-.43 \pm .10$. These coefficients indicate a definite tendency for both the number of practice periods and the number of errors to decrease as the age of the child increased. However, the indi-

TABLE 2

Number of practice periods and number of errors for age groups on the size relationship test

	THREE-YEAR-OLDS		FOUR-YEAR-OLDS		FIVE-YEAR-OLDS	
	Practice periods	Errors	Practice periods	Errors	Practice periods	Errors
Total	77	158	60	52	50	19
Mean	7.7	15.8	6.0	5.2	5.0	1.9
Median	7.0	10.0	6.0	4.0	5.0	1.0
Range	6–12	2–54	4–8	0–16	4–7	0–11

vidual differences within any age group were very large as table 1 indicates. For example. D. M. in the three-year-old group did not make an error on series 1 whereas W. H., although approximately two months older, made 37 errors on this series.

Mental age factor

Mental ages were available only for the two and three-year-olds. Using the rank-difference method, correlations were computed for the 10 three-year-olds to show the relation of metal age to ability to learn to select the middle-size box. The following correlations were obtained:

	PRACTICE PERIODS	ERRORS
Chronological age	−.54	−.47
Mental age	−.74	−.69

These results can only be taken as suggestive but they indicate that mental age was more important than chronological age in ability to learn to select the proper box.

Analysis of errors

On the average, fewer errors were made on each successive series that was presented to a child. Of a total of 247 errors made by the 31 children who completed the 4 series, 169 were made on series 1, 36 on series 2, 27 on series 3 and 15 on series 4. Thus 68 percent of the total number of errors were made on series 1. This shows that in general when a child learned to perform correctly in the first series the performance in the succeeding series was with few or no errors. The cases of child W. H. and child C. W. illustrate this. W. H. made 37 errors before leaving the first series. Thereafter he made but one error. C. W. made 51 errors on the first series, but having learned it he made only 3 errors thereafter. However, there were a number of individual exceptions. J. C. H. G., N. S. and B. L. made no errors until the second series was presented; R. P., B. H., and D. M., made none until the third series; G. D., and G. G. made none until the fourth.

In some cases errors were evidently due to choices being made too hastily. For example, B. H., in the five-year-old group, made 1 error on the third series and 1 on the fourth. In each case his choice was the former middle-size box which he selected quickly. He recognized his error at once and in each case made his succeeding selections without hesitation. Other children probably learned to make the correct choice in series 1 through observing the demonstration but their perception of the relation existing among the boxes was not clear enough to guard them from future errors. Or, again they may have learned to select a particular box during the demonstration, which led them to choose incorrectly in the following series.

It may be, that during training a child learns to react to the middle-size box in relation to the 2 other boxes and also to react to it as a box of a particular size independent of the other boxes. When the new box is introduced the child is confused because these 2 products of training become opposed to each other, the one favoring the choice of the middle-size box in the new series and the other the choice of the largest box which was

the middle-size box in the preceding series. In some cases the larger box will be chosen a few times until the correct box is learned—or the confusion may lead to the choice of the small box instead of either of the boxes to which the products of training have been attached.

Unless the size relationship of the boxes is perceived as an abstraction this difficulty may occur when each new series is presented. Those who make no errors until series 3 and 4 may experience confusion when the second series is presented, but if they happen to make a correct choice on the first trial, the memory of the particular box selected on series 1 tends to become weakened. They may then make correct choices by selecting the proper box because of its particular size just as they did in series 1.

The children who went through the 4 series without an error evidently learned the size relationship as an abstract principle during the demonstration.

Many of the errors occurred when a child formed the habit of choosing the box by its position alone and not by its size. Thus some children consistently chose the box to the right, or to the left, or in the middle position and persevered in this habit in spite of their failure to discover the toy.

Omitting the demonstration trials and those trials when the younger children could not be induced to designate a box because they had not yet learned that the toy was under a box, the children who failed the test had altogether 684 trials. If we consider as systematic choosing only those cases when a choice on the basis of position was adhered to for at least 3 successive trials, we find that 353 choices or 52 percent of all the choices of this group were made on the basis of position. B. B., the only child in the two-year-old-group who completed the test, made no choices on the basis of position. This behavior was found very rarely among the oldrer children. B. P. in the two-year-old-group is an extreme example of the tendency to choose on the basis of position. He chose the box in the middle position 11 out of 15 trials during the second practice period. In his third practice period he chose the box to his left 12 out of 15 trials. During the fourth practice period he chose the box to his left on the first 7 trials and the box in the middle position on the remaining 8. In the fifth practice period he chose the box to his right the first 7 trials, the box in the middle the next 3 and the box to his left on the last 5 trials.

Table 3 shows that confusion of the correct box with the largest box occurred twice as often as with the smallest. Of a total of 247 errors made by the 31 children who completed the test the largest box was chosen 165 times and the smallest 82.

A. J. Kinnaman (1) reported that in learning to discriminate among 6 food boxes of varying size his monkeys were confused by far the greater number of times by the larger boxes. He suggests that this may either be because the larger form could contain more fruit and so seemed more desirable, or that the larger boxes were chosen simply because they were more conspicuous because of their size.

The first of these suggestions does not seem to apply very well to the present study. In the first place, size

of toys is not a factor influencing their choice by young children, especially toys representing live objects which are very large. In fact the children seemed charmed by the small size of the toys. Also there were many comments about the smaller boxes when they were introduced. It seems likely that some of the errors were made in the later series just because the tiny box had an almost irrestible appeal for some of the children. There were frequently such remarks as: "I love that tiny, baby box."

TABLE 3

Analysis of errors according to size of box selected

SERIES 1		SERIES 2		SERIES 3		SERIES 4		TOTAL	
Large	Small	Large	Small	Large	Small	Large	Small	Large	Small
112	57	22	14	19	8	12	3	165	82

Kinnaman's second suggestion, however, that the largest box is chosen because it is more conspicuous seems quite plausible as applied to this test. It might be thought that the confusion with the largest box occurred because that box was remembered as the correct box from the previous series. That may be the fact in some cases but the errors made on the first series makes this objection implausible. In this series the largest box was chosen 112 times and the smallest 57—practically the same ratio as for the 4 series combined.

Here again individual differences are encountered. Several children were confused more often by the smallest than by the largest box in the first series. It is probable that to these children the smallest box appeared more desirable and so more conspicuous. Several children were much more confused by box number 4 than by number 2 in series 2. These children may have learned to make the correct choice in series 1 through a recognition of the size of the middle-size box which was not well enough remembered to lead to the choice of the big box when series 2 was presented. They may thus have been led to choose number 4 because it was conspicuous by its newness.

Interest

Most of the children accepted the examiner's word that they were playing a game and entered into it with the play spirit. This was especially true of the older children, most of whom were successful from the first. B. M. was the only five-year-old who had any difficulty with the game. On the second day, after making several mistakes, he said: "I'm getting tired." This was, however, the only remark of the kind that he made.

Restlessness seldom occurred except when there had been failure. Frequently there was failure without restlessness which appeared in some cases to be due to determination and in others to be the result of satisfaction with incorrect responses.

The older children were more attentive than the younger. It was very difficult to get the two-year-olds to watch during the demonstration and if there was any delay between trials they would run around the room. In general, their attention was fixed only when they were physically active. The older children were very quiet during the demonstration and with the exception of M. E. and B. M. seemed never to tire of playing.

One of the outstanding differences among the groups was the shift of interest from the boxes and toys as noticed in the two-year-old-group to an interest in the game itself by the older children. All the children liked the boxes and the little toys but the five-year-olds and several three and four-year-olds were interested in their score. Children frequently asked if they were getting as many right as some of their friends. There was very little of this interest among the two-year-olds. The direction of attention probably was an important factor in the general failure of the two-year-olds to handle the situation effectively. As Köhler said of the chimpanzees in discussing his experiment with the "Choice Boxes," instead of looking carefully at the box after making a correct choice with a view of discovering its distinguishing characteristics for future use, they "—were carried away by their immediate interest in the goal before them—."(2)

SUMMARY

A study was made of the behavior of 40 children between the ages of two and five years in learning to choose the middle-size box in a series of 3 boxes varying proportionately in size. After the child had learned to make the selection correctly in the first series, the largest box was replaced by one smaller than the 2 remaining boxes and he was again asked to select the middle-size box. This process was repeated through 4 series.

From an analysis of the data thus obtained the following are some of the more pertinent results:

1. The test was beyond the ability of 9 of the 10 two-year-olds used in this study.

2. Fifty-two percent of the choices of the 9 children who failed the test were made on the basis of the position of the box.

3. The 31 children who completed the test gave almost no evidence of selection on the basis of the position of the box.

4. The number of errors and the number of practice periods required to learn the 4 series decreased with age.

5. Success in learning the test was correlated highly with mental age for 10 three-year-old children.

6. Direction of attention to the boxes and interest in making correct choices were factors in success.

7. The 31 children who completed the test confused the middle-size box with the largest box in a series twice as often as with the smallest one.

8. Sixty-eight percent of the errors made by the 31 children who completed the test were on series 1. This indicates that the children learned to select the middle-size box in relation to the other boxes rather than to select a particular box. Once having learned the concept of "middle-sizeness" on the first series of boxes they were able to apply this concept to succeeding series.

9. There were large individual differences in learning.

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Racial Differences in Bi-Manual Dexterity of Latin and American Children

EMILY O. LAMB

IN TESTING Latin and American children with the Stanford revision of the Binet-Simon tests, over a period of ten years, the writer arrived at the conviction that Latin children are more dexterous with their hands than American children; so this investigation has been undertaken to prove or disprove that belief.

Hollingworth and Poffenberger (5) in discussing form-board studies of different races, made by Woodward, (15), ask, "are there characteristics of mind peculiar to different races of men, which need to be considered from the point of view of efficiency?" There is "practically no attempt to separate the facts of inheritance from the effects of education, customs and general environmental conditions." "Experiments have been made on rather simple functions, such as sensory acuity, motor ability and simple judgments. Although the traits are simple, yet they are characteristics in which peoples are supposed, in the popular minds, to differ. The upshot of all the experimental tests seems to show that the racial differences in fundamental qualities, independent of training, are slight."

Woodward (15) considered the form-board test he used to be a fair test of intelligence, and depending very little on training. He found "between whites, Indians, Eskimos, Ainus, Filipinos and Singalese, the average differences were small and much overlapping occurred." But between these groups and the Ingorot and Nigroto from the Philippines and a few Pigmies from the Congo, the average differences were great and overlapping was small. Woodward says that the results would seem to indicate differences in intelligence, but as the fairness of the test is not beyond question, it may have been a more unfamiliar sort to these wild hunting folk than to the more settled groups.

Herrick's (4) studies of Brahman and Panchama children in South India, bring out interesting points on the question of physical maturity. At four years Brahman children exceeded American children in quickness of reaction, but at five years the American children have caught up, and from six years on the American children hold the lead, being faster at every succeeding age studied. Herrick gives as one of the causes that in the tropics children mature earlier than in colder climates, so it is not surprising that four year old Indian children should be capable of faster performance than American four-year-olds.

Paschal and Sullivan (10) gave a series of standardized performance

tests to Mexican children to attempt to determine racial differences in the mental and physical development of Mexican and American children. They found considerable overlapping in the top third of the distribution of most tests, but from the median downward the American children show increasing superiority, the difference being greater at nine years than at twelve. Less sex difference is found in Mexican children than in American children on performance tests.

Koch and Simmons (8) in an experimental study of American, Mexican, and Negro children, found that the city white children are younger, in grade for grade comparisons, than are the city Mexicans. That the city groups, whether American or Mexican, are younger for their grades than are their respective rural groups.

Murdock (9) studied 3 different racial groups in Hawaii, the Chinese, Japanese, and Korean, and found that the Chinese and Koreans were superior to the Japanese in tests involving language but in the Beta test the superiority of the Japanese is clearly shown.

Seashore (13) makes the statement in his "Psychology of Musical Talent":

"Thus we find among children those who are slow and sure, slow and erratic, quick and sure, quick and erratic, and no one seriously expects these tendencies to be altered any more than he expects the leopard to change his spots. These permanent peculiarities we call 'the personal equation.' Reymert (12) carried out a study of a series of reactions of various muscle groups, to validate Seashore's claim, on the assumption that if the personal equation existed, it would manifest itself within recognizable limits. His conclusions were that 'a distinct personal equation for speed exists,'—with the reservation, however, that this personal equation is to some extent a different one for instantaneous motor performances than for motor performances of a continuous nature."

Other findings, which seem to indicate a "personal equation" are requoted by Ream (11). In an experiment on tapping rates, he states that,

"Every individual has his own motor set-up, one is geared slow, and another geared fast, the chief factor—is probably a physiological openness of nerve paths which is inherited. The extended practice experiments of this study seemed to indicate that the test measures fundamental basic abilities since improvement was, on the whole, conspicuously lacking. The inference is that the motive neural set, undoubtedly an important condition of such basic ability, is inherited."

Among experiments employing but one hand at a time, is a very extensive and painstaking study by Wellman (14) on the Development of Motor Coördination in Young Children. Some of the results of her study of motor coördination are recorded as follows: There were no sex differences in the scores on either test. The scores at six years nearly doubled those made by the three-year-old children. Movements with the left hand were more difficult than movements with the right hand, and the differences with the 2 hands became greater as age increased. Children who made more accurate movements with the right hand, than others in the group, also made more accurate movements with the left hand.

As early as 1892 Bryan (1) invented a very complicated tracing-board which he used to considerable extent. Among the conclusions he reached was that the maximal rate of move-

ment probably furnishes a test of the general condition of the central nervous system, of the nerve centers by which the muscles involved in the movement are controlled. He estimated that the rate of the child of six years was two thirds the rate of the youth of sixteen. Girls excell boys at thirteen years but are inferior at all other ages.

PROBLEM, TESTS, AND SELECTION OF SUBJECTS

During the teaching and supervising of art in schools in California some years ago, I found, especially in the low elementary grades, little difficulty in interesting both Italian and Mexican children in the subject of clay modeling and other hand work, such as basketry. Moreover Mexican children seemed unusually deft in handling clay and frequently turned out much more interesting results than did American children.

Later, in giving Binet tests to mixed groups, I found that the California Spanish, Mexican, and Italian children seldom failed on such tests as the tying of a bow, and the discrimination of weights, while the American children often failed to score a plus on those tests. Whether these differences are chance, environmental or real differences in ability is a problem upon which little conclusive experimental work has been done.

The purpose of this investigation is to study the results of certain manual processes given to groups of American and Latin childen with the hope that it may throw some light upon the question as to whether there are racial differences in bi-manual ability or whether it is a traditional attitude with some persons to expect Italian and Mexican children to be more gifted manually than American children.

Selection of tests

The tests in this study do not in any way represent a scale of performance tests, such as the Pintner-Paterson scale. Although the 11 tests used do not all require the actual use of both the right and left hand, the tests have been so arranged that the activity or passivity of the left hand was always observed and noted. The chief thought was to choose tests that would be simple and thus avoid discouraging young children, ranging from four years, nine months to seven years, nine months. Another consideration was to find tests that would contain somewhat familiar processes and would be attractive; and it was necessary to make a selection that would require only the simplest directions in order to be certain that the foreign children understood the requirements; moreover the desirability of arranging a group that could easily be completed in one hour or less to avoid fatigue and its consequent inertia and loss of interest was paramount.

As it seemed desirable to have some definite method of getting at the mental status of the subject, and as it would have consumed too much time to give each one a Binet test, two tests were finally decided upon: one was the Goodenough (3) test of "The Measurement of Intelligence by Drawings," the other was a set of picture puzzles based upon Rossolimo's "profile method," which ac-

cording to Johnson (6), Rossolimo designated as a test in the "capacity to combine."

Age and race groups

The ages of five, six, and seven were chosen because it was desirable to select children who had been given little instruction in manual processes. Those ages could be easily obtained in the public schools. The average ages were as follows: Baltimore Americans, 6 years 6.6 months; San Diego Americans, 5 years 7.5 months; Sicilians, 7 years 1.1 months; Mexicans, 6 years 2.8 months.

Social status

The Italian children studied were all Sicilians, found in a city school of Baltimore which was entirely made up of Sicilians. The neighborhood was dirty and ill-kept. The school also was in harmony with the district, with its small, dusty, windswept yard: but it had a corps of enthusiastic teachers; women who were studying their district conditions and endeavoring to better them. The school nurse had gained the confidence of these suspicious and superstitious people, and was doing excellent work with mothers in inducing them to allow corrective and preventive work to be done. Nearly all the children were wearing various amulets around their necks, and one child was wearing the same dress for a year, without having it washed, because the grandmother had promised that she would, if her younger sister lived through a severe illness. The children looked undernourished, many with obvious physical defects. This group was by far the lowest type group studied, and could not compare even with the poorest of the Mexican or San Diego American group.

The determination of what constituted an American child was based upon the fact that the parents, and, as far as I was able to determine, the grandparents were born in America. A group of 52 American children in one of the most exclusive residential districts of Baltimore was tested. Their school was new, beautifully equipped with every modern convenience to do an advanced type of school work. The children in the kindergarten changed to tennis-shoes on coming in doors, and all were taught to tie their own shoe-strings, so their score on this bow-knot test was high. Because of the very different social status and environment of this group in comparison with the Sicilians and Mexicans, I have used another American group, whose school and home conditions were more nearly comparable for correlations with the foreign groups.

The other group of American children was selected from the same school that the Mexicans came from, and were children living in the same neighborhood as the Mexicans, and in comparable limitations of income and housing. The average age of this American group was 5 years 7.5 months, while the average age of the Baltimore group was 6 years 6.2 months. In none of these studies did I find any group living in the squalor and poor housing that I found the Sicilians living in. Not that such conditions for other nationalities possibly could not be found, but, living for the Mexicans, for instance, in Southern

California does not offer the problem of over-crowded cities and lack of space and the closing of houses to fresh air in winter, that such a city as Baltimore offers. However, Goodenough (2), in comparing the living conditions of Chinese and Japanese in California with Italians, states that social pressure of "race prejudice" is often urged as a reason for the segregation of certain racial groups within poorer neighborhoods; but that

> "it should be remembered that while racial prejudice may bring about segregation, the character of the neighborhoods thus set off is primarily dependent upon the people living in them. It is doubtful whether even the southern Negro has more to contend with in the way of this prejudice than the Chinese or Japanese in California; yet the contrast between the typical Oriental neighborhood and the Italian (or Negro) district is marked. Poverty there may be, but the squalor which is characteristic of the Italian (and the Negro) sections is lacking."

The Mexican children were all the first generation born in the United States. The group of Mexicans represented in this study was tested in one of the San Diego Public Schools, located in a Mexican district, while a few were taken from kindergartens in Santa Barbara. In each class, however, the entire group of five, six, and seven year old children was examined. The San Diego school building was very much like the one in Baltimore where the Sicilians were housed, but it was augmented by many bungalows in the school yard. In these were held the lower primary and kindergarten classes. The yard was inadequate in size and equipment, but because of the mild climate, all the physical exercises were done out of doors, as well as many class recitations and activities.

The numbers in the groups tested are nearly equal: Sicilians 55, Mexicans 53, San Diego Americans 50, and Baltimore Americans 52. The sexes are unequally divided, for it seemed a less selective method to take all the children of the three age-groups in the classes, than to take the same number of girls as boys. So the groups run: Sicilian boys 24, girls 31; Mexican boys 18, girls 35; San Diego American boys 22, girls 28; Baltimore American boys 26, girls 26.

ORDER OF TESTS

Careful consideration was given to the order of presenting the tests; since the series took an hour to give, fatigue and loss of interest had to be avoided.

The following order was finally decided upon as it seemed to offer the maximum of variety in those to be performed while standing and those performed sitting:

Peg board	standing
Drawing of man	sitting
Tying of bow	sitting
Goddard formboard	standing
Nut and bolt	sitting
Buttoning of belt in back	standing
Peg board in colors	standing
Threading of needles	sitting
Motor coördination	sitting
Picture puzzles	sitting
Stringing buttons	sitting

DRAWING OF A MAN

For the Goodenough Drawing test the child was given a 9 by 12 inch sheet of drawing paper and a large soft pencil; the directions were as follows: "On this paper I want you to

TABLE 1

I.Q. score in the test of the drawing of a man

	C.A.	M.A.	I.Q.
		Mexican	
		Boys	
1	5–3	6–3	119
2	5–4	6–6	122
3	5–4	5–0	99
4	5–4	5–6	103
5	5–7	4–9	85
6	5–11	8–3	140
7	6–0	6–9	102
8	6–0	7–3	121
9	6–1	7–9	127
10	6–1	6–9	111
11	6–5	6–3	97
12	6–6	5–6	92
13	6–7	5–9	88
14	6–7	10–0	147
15	6–8	6–9	101
16	7–0	7–0	100
17	7–0	9–6	135
18	7–1	7–6	105
		Girls	
1	4–9	6–0	126
2	4–10	5–3	108
3	5–0	6–0	120
4	5–0	5–9	115
5	5–0	5–3	105
6	5–0	6–0	120
7	5–0	6–3	125
8	5–2	6–0	116
9	5–3	6–9	128
10	5–3	5–9	109
11	5–4	6–9	126
12	5–5	7–3	134
13	5–7	5–3	94
14	5–8	7–0	123
15	5–8	7–6	133
16	5–9	7–3	126
17	5–9	5–3	91
18	5–11	6–9	114
19	5–11	6–0	101
20	5–11	7–6	127
21	5–11	6–9	114
22	5–11	5–0	85
23	6–0	6–6	108
24	6–0	6–6	108

	C.A.	M.A.	I.Q.
		Mexican—Concluded	
		Girls—*Concluded*	
25	6–1	7–3	119
26	6–2	5–3	85
27	6–4	10–9	170
28	6–7	7–3	111
29	6–7	7–0	106
30	6–7	6–0	92
31	6–9	9–6	140
32	6–11	5–3	76
33	7–0	6–6	93
34	7–5	6–6	87
35	7–6	7–0	93
		Sicilian	
		Boys	
1	4–10	6–0	123
2	5–5	7–0	128
3	5–9	6–6	112
4	6–1	8–9	143
5	6–5	5–0	73
6	6–5	5–3	82
7	6–5	6–3	97
8	6–5	7–9	120
9	6–7	5–0	76
10	6–7	6–3	95
11	6–7	6–9	102
12	6–7	5–6	84
13	6–7	7–3	110
14	6–7	5–9	87
15	6–10	7–6	110
16	7–0	5–9	82
17	7–0	5–9	82
18	7–1	5–6	78
19	7–1	5–3	74
20	7–2	7–3	101
21	7–2	9–0	125
22	7–3	6–6	89
23	7–3	8–6	116
24	7–3	6–6	90
		Girls	
1	4–6	5–0	111
2	5–3	5–6	105
3	5–7	7–0	125
4	5–8	7–0	123
5	5–9	5–9	100

TABLE 1—*Continued*

	C.A.	M.A.	I.Q.
Sicilian—Concluded			
Girls—*Concluded*			
6	5–9	6–6	113
7	5–9	7–9	135
8	5–9	6–0	104
9	5–10	6–0	103
10	5–10	6–3	107
11	5–10	5–9	98
12	6–3	6–9	107
13	6–3	7–6	120
14	6–4	6–6	102
15	6–4	7–0	110
16	6–5	10–0	155
17	6–7	6–0	89
18	6–7	6–6	99
19	6–9	5–3	78
20	6–10	6–9	98
21	7–0	7–0	100
22	7–0	7–3	104
23	6–7	6–0	92
24	6–8	5–9	86
25	7–0	6–0	86
26	7–1	6–9	95
27	7–1	5–6	78
28	7–3	6–6	89
29	7–4	9–0	122
30	7–4	7–6	102
31	6–8	6–3	94
San Diego American			
Boys			
1	4–11	6–3	126
2	5–0	5–0	100
3	5–2	4–6	87
4	5–4	5–4	100
5	5–4	5–3	98
6	5–4	5–9	107
7	5–4	5–0	93
8	5–4	5–9	107
9	5–7	5–3	94
10	5–8	4–9	84
11	5–9	4–9	83
12	5–11	6–6	110
13	5–10	6–6	103
14	6–0	6–9	102
15	6–1	6–9	111
16	6–5	5–9	90
17	6–7	7–0	106
18	6–7	6–6	99
19	6–9	6–6	96
20	6–9	7–0	103
21	6–10	4–9	70
22	7–1	6–6	93
Girls			
1	4–6	5–6	122
2	4–7	6–0	130
3	4–10	4–3	87
4	5–0	5–3	105
5	5–0	6–3	125
6	5–2	4–6	87
7	5–2	5–3	101
8	5–3	6–3	119
9	5–3	6–0	114
10	5–4	5–9	107
11	5–5	6–6	120
12	5–6	5–6	100
13	5–6	7–3	133
14	5–7	7–6	135
15	5–8	5–0	88
16	5–9	5–6	96
17	5–9	6–9	117
18	5–9	4–6	79
19	5–11	5–6	93
20	6–0	7–3	121
21	6–0	4–6	75
22	6–0	6–9	112
23	6–2	5–6	90
24	6–2	5–3	85
25	6–4	7–0	110
26	6–8	6–9	101
27	6–9	6–6	96
28	7–1	5–6	78
Baltimore American			
Boys			
1	5–5	3–9	69
2	5–5	5–9	106
3	5–7	5–6	98
4	5–7	7–0	125
5	5–7	8–0	143
6	5–9	6–6	112

TABLE 1—*Concluded*

	C.A.	M.A.	I.Q.
Baltimore American—Concluded			
Boys—*Concluded*			
7	5–9	6–9	117
8	5–11	7–9	131
9	6–0	7–3	125
10	6–2	6–0	97
11	6–3	7–0	112
12	6–3	6–3	100
13	6–4	6–0	95
14	6–5	5–9	89
15	6–8	6–0	90
16	6–9	4–0	60
17	6–9	6–6	96
18	6–9	6–6	96
19	6–9	5–6	81
20	6–9	6–9	100
21	6–10	6–3	91
22	6–11	6–9	97
23	7–1	5–6	78
24	7–3	6–0	83
25	7–3	8–0	110
26	7–5	6–9	91
Girls			
1	5–1	5–3	102
2	5–3	7–9	147
3	5–4	6–0	113
4	5–5	5–3	97
5	5–7	7–0	125
6	5–7	6–0	108
7	5–8	8–0	135
8	5–10	6–6	111
9	5–11	10–6	176
10	6–0	6–3	104
11	6–0	7–9	128
12	6–0	6–0	100
13	6–3	6–6	104
14	6–7	6–9	102
15	6–8	6–0	90
16	6–9	6–0	89
17	6–9	6–0	89
18	6–10	7–0	103
19	7–0	6–6	93
20	7–1	6–6	92
21	7–2	8–3	142
22	7–4	6–6	88
23	7–7	7–6	98
24	7–8	9–0	117
25	7–9	11–0	142
26	7–2	8–3	115

make a picture of a man. Make the very best picture that you can. Take your time and work carefully."

Some of the children had to be encouraged to make a start but not a child refused to make the drawing. Many of the American children chatted all the time they were drawing, naming each part as they put it in. This chatting was not so voluble with the foreign children, although they commented on an item now and then.

Over 77 per cent of the total test of the Drawing of a Man by the 53 Mexican children gave a higher mental age than the chronological age of the child; 58 per cent of the Sicilians, 56 per cent of the San Diego Americans and 60 per cent of the Baltimore American group.

The drawings made by the Sicilian group were unlike those of the other groups in that they contained much more anatomical detail. Very often a circle or elipse across the middle of the trunk was "the belly." The navel was often represented. These drawings were, on the whole more dramatic than those of the other groups. The man would be running, or raking, or smoking, or even shooting. One man had a large pistol in his pocket. The fact that they were drawing "a man" was evidently seldom remembered by any of the children, for when they clothed him, he was just as liable to be wearing a dress as coat and pants. The incongruities seemed to be unrecognized by most of the children: the fact that the man was wearing nothing but a tie or hat with no other clothing received no consideration.

It is a notable fact that the difference in social satus and type of environment of these groups is clearly shown by the comparison of the drawings of

the Sicilian group, who came from very poor and ignorant homes, with the drawings of the American group studied in Baltimore. In the latter group more clothing is shown, and such things as golf-sticks and canes and umbrellas were depicted. One drawing is of a "Pilgrim." In not one is the stomach drawn nor the navel. In the drawings of the Sicilian children fewer show clothing, and when the man carries something, it is usually a gun. One child, when he was finishing, put a vertical and horizontal line across the trunk; when asked what it was he said, "The cross of Jesus." Another child, after finishing the drawing of the man, drew a series of vertical lines in the space to one side. I asked what that was, and he said, "Macaroni for the man to eat."

One Mexican child drew a man with six fingers, a line out from each finger and a circle on the end, this was a "balloon man." Such comments as "he's running," "he's shooting a gun," would come from the foreign children, but the American children often told a whole story about their drawings as they progressed. Only a few children, in any of the groups, drew profile; almost all were front view. In a few cases the children drew the man upside-down through-out the entire test, but in all cases, when they had finished they turned the drawing around to the correct position. Quite a number began with the legs instead of the head.

In over two hundred drawings only one could be said to show what Goodnough (3) terms "flight of ideas." The arms and hands were like feather dusters and were huge as compared with the size of the rest of the figure. The feet were like lily-pads with lines like the veins of the leaves, running out from where the legs form the feet. The head was mostly hair. This child was five years, four months old, and was considered a great problem in school. She showed little ability to give attention and was erratic and unable to follow directions. The mother was much troubled about her, but the mother also showed a high degree of nervous tension, was very anxious and extremely talkative.

The only other drawing that was unusual was done by a boy of five years, five months. This consisted of an oblong with 2 circular scribbles in the right half, joined to another small oblong. When asked what these were, he said, "Eyes, mouth, nose, big feets." The "big feet" were the sides of the smaller oblong. This drawing does not come into the class showing indications of psychopathy, however, but simply shows unusual immaturity. He was a tiny, very babyish child in looks and in speech and made a mental age by the drawing test of three years, nine months. Both these children were in the socially highest-type group.

Left hand

After the drawing of a man was completed with the right hand (only 3 preferred the left hand) then the picture of a man was drawn with the left hand. Many of the children did not hesitate, but put the pencil into the left hand and started drawing at once, but others said "I can't;" one child said, "I'll make a funny man." For many of the children the change

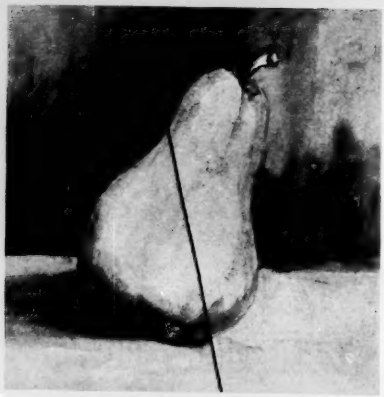


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

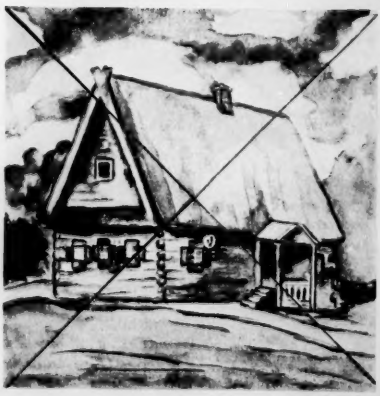


FIG. 6

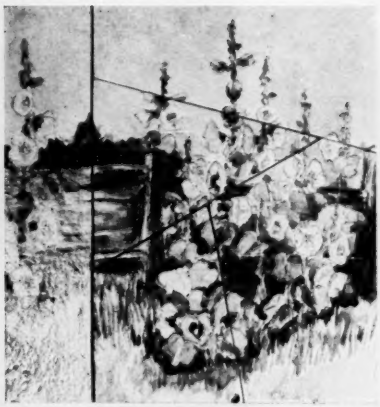


FIG. 7

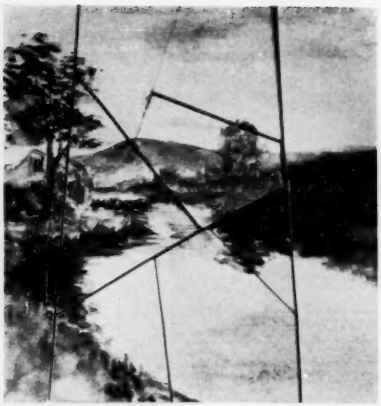


FIG. 9

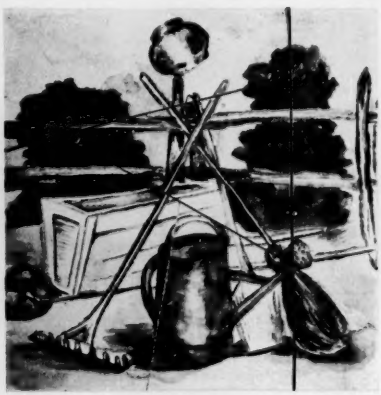


FIG. 8

FIG. 10

was so awkward that they had to make a great effort to do it. One child put his tongue in his cheek, several "chewed their tongues." There were a number of children who appeared to use the left hand as easily as the right. They showed fairly good motor-control; the lines were firm and the joining of lines good.

In most of the cases where the use of the left hand seemed so difficult, the right hand would go over to the left again and again to help, especially when it came to the drawing of the features and other details. Without seeming to realize it, the child frequently changed the pencil back to the right hand. For the most part, those who found the left hand drawing difficult would hold the pencil with fingers far back from the point, or would hold it with a fist-like grip and press down hard upon the paper.

There were children who appeared to be ambidextrous and who seemed to enjoy using the left hand. One of these children, when making the first drawing, would use the right hand to work on the right side and would change the pencil to his left hand when drawing the details of the opposite side of the picture. In most cases the use of the pencil for drawing with the left hand was difficult. The position of the hand in holding the pencil was awkward and the motor-control much poorer than when the right hand was used. The opposite was true for two of the children who were left-handed.

PICTURE PUZZLES

The picture puzzle test was placed as the eleventh in the last of performance tests, but since it was based upon the Rossolimo test that was designed to measure mental capacity the discussion of it is given here in order to compare it with the standardized test of Goodenough (3). This test has not been standardized, nor are there norms for the Rossolimo.

This test consists of a graded series of 10 pictures 6 by 6 inches done in water-color, mounted on fourply veneer, shellaced and cut. The subjects are similar to the Rossolimo series but substitutions have been made for the 5 familiar objects that seemed to the writer to be more attractive to young children than Rossolimo's, and the 5 geometric figures that are black on a white ground in the Rossolimo, have been changed to color. The circle is red; the square, orange; the oval, purple; the snake-like design, two tones of green; and the star, two tones of blue. As the Rossolimo series is copied in water-color and the white water-color paper soils so quickly the substitute set is protected by shellac. Otherwise one set of dissected pictures might not have lasted through the experiment. This process has somewhat changed the character of the color, yellowing the whites, and mellowing the brilliancy of the colors. It is just possible that had picture varnish been used there would have been a little less change in the color. The 10 pictures are cut in the same shapes as those of the Rossolimo series.

The five that have been changed as to subject are shown in the accompanying photographs. For the geometric figures see Johnson (7).

One reason for putting this series toward the end of the gamut of tests

was the thought that the performance took a much longer time than any other single test and that it might be discouraging if given toward the beginning. Then, too, the child tested would be better acquainted with the examiner and more at ease, and so would be likely to make a better pro-

was kept with a stop-watch; 3 minutes being the limit of time allowed for each picture.

The method of procedure, was similar to Johnson's in stopping the test after 2 successive failures were made. In a few cases she allowed the child to try other pictures after 2 failures, but

TABLE 2

Scatter of failures in picture puzzle test

PUZZLE NUMBER	5 YEARS				6 YEARS				7 YEARS				TOTALS			
	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans
	Number of children															
	21	11	28	14	25	25	19	23	7	19	3	15				
1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	0	1	3	0	1	0	3	0	0	0	0	1	1	1	6
4	1	2	2	5	2	2	0	2	0	1	1	0	3	5	3	7
5	4	5	12	6	0	7	0	5	0	9	0	2	4	21	12	13
6	1	1	4	4	3	4	2	5	0	1	0	0	4	6	6	9
7	10	8	17	9	8	19	0	12	0	8	0	5	18	35	17	26
8	8	5	18	12	7	19	8	16	1	11	2	7	16	35	28	35
9	21	11	28	13	23	22	19	23	7	19	3	13	51	52	50	49
10	20	9	27	14	17	23	16	22	5	18	3	13	42	50	46	49
Total....	66	42	109	66	60	97	35	88	13	67	9	40	139	206	163	194

longed response. Experience with these 212 children makes me conclude that this was probably a wise decision.

Procedure

The pieces of the pictures were placed in the same order for presentation as that given by Johnson (6) but the instructions were slightly changed, and were as follows: "This is a picture that has been cut into several pieces, see if you can put it together again to make a picture." The time record

she states that in no case was the attempt successful.

With the series of pictures substituted in this experiment for those of the Rossolimo series, all the children were allowed to try all of the pictures, stopping the trial at the three-minute time-limit for each picture. The findings differed from Johnson's in the matter of successful scores after 2 successive failures, which leads to the question as to whether the series used in this study is as well graded as the

Rossolimo series. With this possibility, or perhaps probability, in mind, the method of scoring was changed. Instead of considering the score to be the "number designating the place in the series of the final picture which is correctly solved," (after 2 successive failures), the aggregate of all the correctly solved pictures was used as the score. This lowers the score in some cases where the final result showed much scattering.

The scores given in table 2 show the extent of scattering. Although the burden of failures is found on puzzles 9 and 10, yet it also shows that quite a number of individuals succeeded with picture 10 who failed with 9. As picture 9 is one of the substitutions for the Rossolimo pictures, it may be that the one used in this study presents more difficulties than number 9 of the Rossolimo series.

In table 3 showing the distribution of scores, the Mexican group is far in advance of all the other groups in the number of high scores, the aggregate being 8 for score 9, and 1 for score 10. Neither the San Diego American group nor the Sicilian group had a score of 10; the Baltimore American group shows one such score.

TABLE 3

Distribution of picture puzzle scores

SCORE	5 YEARS				6 YEARS				7 YEARS			
	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans
0												
1												
2								1				
3	1			3								
4	2	3	4	2		4	1	2		1		
5	3	4	5	2		4		3		1		
6	2		10	4	1	10	3	7		5		4
7	9	3	9	3	6	5	3	3	1	7	2	2
8	11	3	4	3	6		7	6	2	3		5
9	1	1			4	1	2	1	3			
10					1							1
Total.....	29	14	32	17	18	24	16	23	6	17	2	12
Average..	6.7	6.0	6.1	5.7	7.8	5.8	7.9	6.8	8.3	6.5	7.0	7.3

It was notable throughout this test that during the first of the series, where the picture was relatively simple for most of the children the stimulus-pattern was the picture represented, but as the picture became more complicated, they began to work to fit shape rather than design.

In the case of the Mexican boy who had a score of 10, picture-design was his motive throughout. In puzzle 9, he said, "This is a house and it's near the water." In the star he systematically put the corner squares to-

gether, making the design match; then he put the four squares together, clearly showing that the picture pattern was what he was working for. One little girl who also worked for design throughout said, "The sky is at the bottom of the picture, too;" referring to the reflection of the sunset in the water. Many of the children in doing the star-puzzle seemed to work for pattern, but were satisfied with a very irregular picture-pattern result. Some of the younger children showed the tendency that Johnson (6) reports: In putting the third picture together, they would put the pieces in a row and say "Baby;" or perhaps they got three pieces together correctly, then put the fourth in in whatever way it happened to lie on the table, and were satisfied with the result.

When the San Diego groups were examined it was near Easter, and many of the children at once said, "It's an Easter egg" when they correctly solved the puzzle with the oval pattern. The majority of the children named the pattern as soon as they had the pieces put together correctly. The red circle was usually called "a red apple." Twice the orange square was called a "handkerchief" by girls. Some of the children would get pieces together correctly, not recognize the fact and pull them apart again. This was especially true of the snake-like pattern. One little girl who failed on this test said, "That is a hard one, looks like a round snake." One child said of the oval, incorrectly assembled, "It's a water-bottle." One boy who had a score of 4, never did seem to get the real idea of assembling for a pattern. He shoved the pieces around with no apparent idea of what he was working for. This was a San Diego American boy. It was surprising at times how satisfied a child would be with a perfectly incongruous and irregular grouping. One unsuccessful little girl of the Baltimore American group said, "Gosh, I think this is fun!" There were some who, after the first one, used a "trial and error" method throughout the test. One of the Sicilian group made a score of 9, using this method.

PLAIN PEG BOARD

The first test given was a peg board. This board is of varnished maple, with pegs to match. The size is 12 by 12 inches with 36 half-inch holes, 6 on a side, equidistant, leaving a margin of $1\frac{1}{2}$ inches. The pegs are 3 inches long and $\frac{7}{16}$ inches in diameter, with the edges of both ends beveled to prevent the peg from chipping and from being difficult to slip into the hole.

The pegs were in a shallow pan at the right of the board (at the left, if the child were left-handed). The table was low, so the child looked down upon the board as he stood in front of it.

The directions were: "Put your left hand (indicating it) on the lower corner of the board, and with the other hand put all these pegs in these holes just as fast as you can, picking up only one peg at a time. Ready, go!" The time was kept with a stop-watch.

Most of the children began to put in rows of pegs beginning at the right side, and either put the pegs in rows from front to back or from back to front; but some worked forward and back all the way across the board in-

stead of starting each new row at the front. Few of them had the idea of starting at the left side and so avoid reaching over those pegs that were already placed. Almost every combination of method was employed; however, the most frequent was in rows from front to back or the reverse, with the exception of the San Diego groups. There were only 2 children who used a hit or miss manner.

The San Diego children, almost without exception, put in all the outer rows of pegs first, then filled in the center either in concentric squares or in rows across. This was the only group of children who used this method; a very few individuals had done so. In talking with the teachers of this group one kindergartener said that in their use of the peg board they generally told the children to put a fence all around the board first.

The averages for all the groups were very close as is shown in table 4.

Both the best and the poorest records appear in the Baltimore group of American children, the best record being 59 seconds. This was made by a little girl of seven years, four months who made a record of ten years, three months on the Drawing of a Man and a score of nine on the Picture Puzzles. However, on the finer coördinations, such as the threading of needles, she was very slow, taking 4 minutes and 30 seconds to thread the six needles. She was left-handed.

All the children who were left-handed were allowed to use that hand. The poorest record was made by a boy five years, five months who took 2 minutes 50 seconds for the test. His rating for the Drawing of a Man gave him a mental age of three years, nine months and his score in the Picture Puzzles was three. His procedure was unlike that of the other childen in that several times he picked up a whole handful of pegs, and was sufficiently distractable to leave the board at one time to ask if we were going "to play a game with those," pointing to other apparatus. He was a tiny, undeveloped child, very babyish in his manner.

In the other 3 groups the highest as

TABLE 4

Average time for peg-board

	BOYS		GIRLS	
	minutes	*seconds*	*minutes*	*seconds*
Mexicans:				
Plain	1	28	1	26
Colored	1	28	1	30
Sicilians:				
Plain	1	23	1	25
Colored	1	32	1	32
San Diego Americans:				
Plain	1	26	1	25
Colored	1	35	1	32
Baltimore Americans:				
Plain	1	26	1	26
Colored	1	30	1	28

well as the lowest records are found in the Mexican group. There were 3 children in this group who took over 2 minutes for this test, the longest record being 2 minutes and 26 seconds. The shortest record was one minute.

There was one child who was so steady in putting the pegs in that her reactions were almost rhythmic. It was difficult, with some of the five year old children to give them an idea of speed. One child of four years,

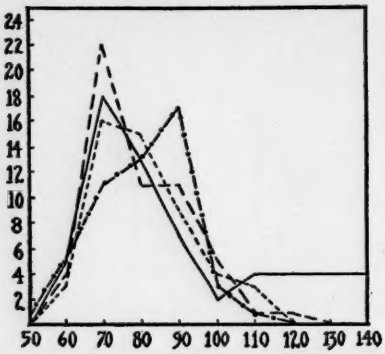


FIG. 1. RELATIVE TIME SCORES. PLAIN PEG BOARD

——— Mexican; ——— Italian; — — — — S. D. American; —o—o— Baltimore American.

seven months stopped to blow her nose, another started to tell me about her baby brother, and held a peg up until she was reminded to hurry. Some of the children were prone to pick up 2 pegs at a time until reminded not to do so. One child did this every time he thought I was not looking. In 2 cases the children had to be urged to "go on," as they appeared to think that after one row was in, the test was finished. One child even started to take the pegs out.

Left hand

All the children who were left-handed were allowed to use that hand instead of the right hand in these tests, in which case the apparatus was arranged with the same relation to the left side of the child as for the right side of those who were right-handed. There were 3 left-handed children, 2 Mexicans and 1 Baltimore American. One of the former appeared to be ambidextrous, especially when using a pencil. At first, when told to "put the left hand on the corner of the board," some of the children would press the left hand down hard until they became interested enough to forget and relax.

COLORED PEG BOARD

Although the Colored Peg Board test is number seven in the list of tests as given, the results of that test will be given here in order to compare them with the results obtained with the Plain Peg Board.

This board is constructed like the other peg board with the exception that it is painted in three stripes of color, one blue, one deep yellow, and one green. Each stripe covers twelve peg-holes, and the twelve pegs belonging in these holes are painted the same color as the stripe.

The directions were:

"Here is another peg board, just like the first one, but in 3 colors, with pegs to match: the blue pegs go into the blue stripe, (illustrate by putting in a blue peg); the yellow in the yellow stripe (illustrate); and the green pegs in the green stripe (illustrate). Put your left hand on the corner of the board and pick up only one peg at a time. Let me see how fast you can put these pegs in the holes where they belong. Ready, go!"

Most of the children greeted the second peg board test with seeming pleasure, and some would have started to put the pegs in before the directions were completed if they had been permitted.

The board was so placed with reference to the child that the blue stripe came to the right, the orange in the center, and the green to the left. The stripes ran at right angles to the front

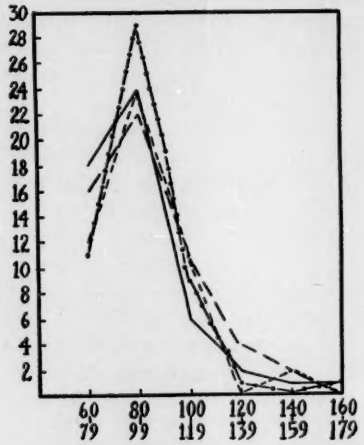


FIG. 2. RELATIVE TIME SCORES. COLORED PEG BOARD

——— Mexican; ——— Italian; — — — — S. D. American; —●—●— Baltimore American.

edge of the table. The pan of pegs was placed at the right of the board unless the child were left-handed, then both pan and board were reversed.

The pegs were thoroughly mixed in the pan so the colors had to be picked out. This may have been a reason why the test took a longer time than the plain peg board, for in the latter test the children who made the best time did not look back at the pan of pegs each time, but picked up a peg without looking. In the case of the colors, the peg had to be selected each time, and, when it came to the last two or three of a color, the child would perhaps have to hunt for them. The pan is which the pegs were kept was large enough for all the pegs to lie flat without covering each other if they had been placed in order, but this was not the procedure.

In over two hundred children tested, not a single child appeared to be color-blind, at least as far as these 3 colors (blue, yellow, green) were concerned. If by chance a child put a peg in the wrong stripe he either changed it immediately or when he found a peg left over of the color he was filling. One child discovered that she had put a blue peg in the green space and said "Do you know why I got the blue one in there? Because my eyes are bad."

The majority of the children selected one color and filled all openings there first, then took another color. But in this, as in the plain peg board test, every variety of procedure was used. One child put one row of each color in first; then filled in the second rows in the same order. Some began with the blue and put in rows front to back and back to front uniformly all the way across, ending with the green pegs. Only one child put into the appropriate stripe whatever peg he happened to pick up without looking. About half of the children filled in the green stripe first, though some of them filled the blue second and yellow last.

There were still quite a number who found it difficult to refrain from picking up more than one peg at a time.

The control of the left hand, as far as its reaching over to help the right hand was concerned, was much improved in this test, though it showed much the same activity or relaxation that it showed in the first peg board test.

The average time in performing this Colored Peg Board test was slightly higher than the time for the Plain Peg Board test. Table 4 shows these differences.

With some children the left hand would leave the corner of the board and be dramatically held out to the side with the fingers spread. Never was that particular manner of holding the left hand observed with the American children. This may have been chance but it seemed worth noting. In a number of cases of both American and foreign children the left hand left the board to grasp the dress tightly, or, in 2 cases to be held against the stomach or with the fingers spread apart. Sometimes the left hand was taken from the corner of the board and the edge of the table grasped. Some of the children held the index finger only on the corner of the board. In several cases the child started to take a handful of pegs in the left hand to feed the right hand. In many cases, more especially among the American children, the left hand would either be held in a relaxed position in the corner of the board or the child would drop it by his side. It was notable that the more tense positions were shown when the child appeared conscious of trying to go fast.

TYING A BOW-KNOT

In the Stanford Revision of the Binet-Simon tests, Terman places the tying of a bow in the seventh year, but in this study it was used for all three ages represented. The procedure differed in 2 points from that given by Terman: first, the term "bow-knot," was changed to "bow" as the word *knot* confused the foreign children. The second point of difference was that the bow-knot was not tied around my finger, as with very young children where there is any shyness to be overcome, it has been my experience that one gets better results if the personal element is entirely eliminated, so a stick was substituted with the model on the same stick.

There is also a time element in the procedure of tying around the finger, the child may feel more hurried than when tying around a stick. The directions were "See, here is a bow; I want you to take this string and make the same kind of a bow on this stick." The criticism made by Terman that the stick often fell out of the string was not true of the test in this study. The stick was large enough (8 inches long and 1 inch wide) so the child kept it down on the table while he worked.

Table 5 shows the distribution. Of seven-year-old Mexicans none failed; of the 19 seven-year-old Sicilians 4 failed; of the 3 seven-year-old San Diego Americans 2 failed; and of the 15 seven-year-old Baltimore Americans 3 failed. The Mexicans show the lowest percentage of failures.

Considering the fact that the Baltimore American children were taught to tie their shoe-strings when they entered the kindergarten and the other 3 groups were not, it seems that the Baltimore Americans showed a high percentage of failures. There were several types of failure in this test;

some had no idea at all about any procedure to accomplish the task, others made the first loop, put the other string around it but when it came to pulling through the second loop they put it through the first loop instead of the wrapped around string. Others laid out 2 loops, 1 for each string-end, then picked up the loops and tied in a knot. This made a two-loop bow that would not pull loose easily but was not like the model.

failures in each group with the San Diego American group, (this is the group used in the correlations), the group making the least number of failures is the trained Baltimore American group. The Mexican percentages are lower for the six and seven-year-olds than the San Diego Americans, but higher in the six-year-old group but the aggregate of percentages is much lower for the Mexicans. The same data are found in the comparison

TABLE 5

Distribution of failures in tying a bow-knot

	5 YEARS				6 YEARS				7 YEARS				TOTALS			
	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans	Mexicans	Sicilians	San Diego Americans	Baltimore Americans
Number of boys	4	3	10	7	11	11	10	13	3	10	2	6	18	24	22	26
Number of girls	17	8	18	7	14	14	9	10	4	9	1	9	35	31	28	26
Boys—failures	2	2	8	2	0	8	4	2	0	2	2	1	2	12	14	5
Girls—failures	8	3	7	1	1	4	1	5	0	2	0	2	9	9	8	8
Totals	10	5	15	3	1	12	5	7	0	4	2	3	11	21	22	13
Percentage of failures	.47	.45	.53	.21	.40	.48	.26	.30	0	.21	.66	.20	.20	.38	.44	.25

When the children failed and were asked, "Don't you tie your own shoe-strings?" the child's invariable reply was "My mother does it." Johnson (6) states that "It was observed that the Italian children who failed almost universally in tying a bow-knot, wore button shoes and upon inquiry it was ascertained that these children rarely wore shoes with laces." In observing the groups used for this study, some of the failures were made by children wearing button shoes but by no means was this universally true.

In comparing the percentage of

of the Sicilian group with the San Diego American group, as for the Mexican and San Diego American. In comparing the Mexican and Sicilian groups, the five-year-olds of the Mexican group show a slightly higher percentage of failures, but the six-year-old group is lower and the seven-year-old group of Mexicans has no failures at all while the Sicilian group has .21 per cent of failures.

In the test of the tying of a bow the Mexican group rates higher than any but the Baltimore American group.

SEGUIN-GODDARD FORM-BOARD

The fourth test was the Seguin-Goddard Form-Board, which is too well known to require a description here; suffice it to say the standard form-board was used. The procedure with these young children was to place the 3 piles of forms to the right of the board and not at the back, because the latter presented some difficulties in reaching for the small children. The directions were: "See how fast you can put these blocks back in the holes where they belong. Ready, go!" The time was kept with a stop-watch. There were 3 trials on this test, the shortest time of the three was taken as the score.

The average time and median for each group was as follows:

The above average scores show that in this test the Mexican group made the shortest time of any of the groups; the longest time being scored by the Sicilian group.

Goddard form-board

	AVERAGE TIME	MEDIAN
	seconds	
Mexicans:		
Boys	29	28
Girls	29	
Sicilians:		
Boys	42	41
Girls	48	
San Diego Americans:		
Boys	31	31
Girls	36	
Baltimore Americans:		
Boys	40	40
Girls	45	

There was no difficulty in securing coöperation on 3 trials, for the children were sent to me "to play games," and they took this repetition as part of the game. At the end of the first trial I said: "We do this 3 times to see if we can do it faster each time." In some cases the shortest time was made on the first trial, but in many of the cases on the second trial. At times it would seem, in observing the performance in this test, as if the last trial was going to prove much shorter, then perhaps the child would fumble in putting in the star or cross, or would

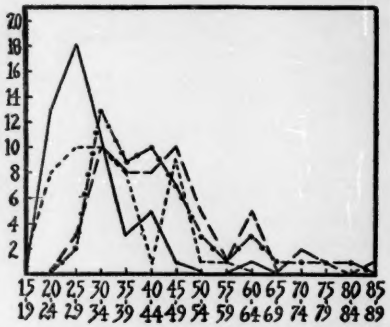


FIG. 3. RELATIVE TIME SCORES. GODDARD FORM BOARD

——— Mexican; — — — Italian; — — — S. D. American; —●—●— Baltimore American.

hesitate over the placing of some form that had gone in with no hesitation in the other 2 trials, and instead of making a shorter time, he would take longer for this trial than for either of the other two. There was one performance that occurred in a number of cases; the child would put the blocks in place in the first trial with practically no hesitation nor "hovering," but on the second trial would begin to hesitate and hold the block hoveringly above the board before

finding its place. Sometimes this response was even more pronounced in the third trial than in the second. Yet all the time such a child had the appearance of greater interest even than in the first trial.

Sometimes a child would drop a block on the board, or lay it to one side on the board, if he did not at once recognize the place for it. Then it would be placed when he recognized its proper place or would be left there to be put in place after all the others were in. Many of the children attempted to put the forms into the wrong places. Most of these mistakes occurred in forms of similar shapes; for example, the ellipse in the circle, or the diamond in the hexagonal space or vice-versa. There were some who tried to fit into the openings shapes that were dissimilar, such as the triangle in the circle and square in the diamond. A few started out with a trial and error method, giving no attention to the shapes but merely trying the blocks in the different openings until they found the right one. This method was not employed after the first trial in any of these cases.

The first performance was often very different from the other performances and offered a much more interesting study, as to the time element as well as the form perception and quality of attention shown.

Left hand

In this test the children were given no instructions concerning the use of the right or left hand, so in some cases the child used the left hand as much as the right hand, after the blocks were picked up by the right hand. In only 2 cases was it noted that the child reached to pick up the blocks with the left hand. The left hand was sometimes used to hold a block for which the proper place was not immediately recognized, and when the place for it was recognized this block would be put in with the left hand.

SCREWING NUTS ON BOLTS

The fifth test was screwing nuts on 6 bolts. The bolts were $4\frac{1}{2}$ inches long and $\frac{1}{4}$ inch in diameter with square head and square nut. They were threaded at one end $1\frac{1}{4}$ inches on the shaft. The nuts were $\frac{3}{4}$ of an inch square and $\frac{3}{8}$ of an inch thick and had been cleaned and slightly oiled when they were new, so the nuts would run on freely. The bolts were laid in a row, the head end toward the child; the nuts were in a row, one at the thread end of each bolt.

The directions were: "I want to see how fast you can put all these nuts on these bolts, running the nuts on as far as they will go, like this." I took up a bolt and, holding it in my left hand, started the nut and then ran it on as fast as possible with the fingers of my right hand, put it down quickly and started to pick up another without actually doing it. The children seemed anxious to do this test and, unless restrained would have started to carry out the directions before I put the bolt back. As soon as bolt and nut were in place, I said, "All right, ready, go!", starting the stopwatch as soon as bolt and nut were in the hands of the child.

There was one feature in this test affecting the amount of time the test took that was true in nearly every case.

If a right-handed child kept the bolt in his right hand and put the nut on with his left hand, almost without exception, the time for completing the task was longer, in some cases very much longer than when the nut was in the right hand and bolt in the left. In the first method the child was apt to experience great difficulty in getting the nut started, for he would screw it the wrong way and sometimes drop it off three and four times; sometimes it would drop to the floor. Some children would suddenly realize what the difficulty was and shift the bolt to the other hand. If they did not do this they were obliged to screw the nut toward them instead of away from them. Some children tried to run the bolt on against the palm of the left hand, but for the most part they laboriously turned the nut on little by little. Some of the children shifted the position of nut and bolt in the hands several times during the test.

A number of the children would hold the bolt upright on the table, balance the nut on top, then run it on with the right hand. The children employed a surprising number of different methods of procedure in performing this task. Some were very particular, in putting the assembled bolt and nut down, to lay it straight on the table and line the next ones up with it. Those who were quickest in the test were the ones who held the bolt in the left hand and ran the nut on either with the palm or fingers of the right hand, or very often with only the first finger of the right hand.

Twice one child changed the direction of the turning of the nut and nearly screwed off 2 nuts before he realized the fact. Then, in changing from a method of slowly turning the nut on, the children would try to run it on in the palm of the hand and would turn the nut off instead of on. Some of the children chattered all the time until urged to hurry. A number of children who had difficulty getting the nut started would change the nut for another. One boy said, "Gosh, this one sticks, I guess it isn't the right one." It was observable that most of the children who had any difficulty in getting the nut started would show a reaction of the mouth, either it would be open, or the tongue would come out, or be twisted. Whenever there was difficulty starting, the children almost universally tried to force the nut on, some pushing as hard as possible with the nut quite crooked on the end of the bolt.

Very few of the children retained the idea of the necessity for speed; once in a while a child would appear to try to "go as fast as he could," but in only 2 cases was this attitude maintained throughout the performance. The comments of the boys on seeing the bolts were; "My father has some bolts like those." "We got some of these in our machine." "I can do that." "Gee! that's easy!" "I have these in my tricycle." The comments of the girls were of quite a different character; "None of the kids can do things as fast as me." "Hard to do, ain't they?" "Come on here, you old nut!"

The shortest time-score for this test was 44 seconds, made by a San Diego American girl; the longest time was taken by a Sicilian child who took 5 minutes 40 seconds for the test.

The average time for the test is as follows:

	AVERAGE TIME	MEDIAN
	seconds	
Mexicans:		
Boys	107	112
Girls	141	
Sicilians:		
Boys	118	125
Girls	191	
Baltimore Americans:		
Boys	119	130
Girls	149	
San Diego Americans:		
Boys	166	120
Girls	157	

The only group in which the girls' average was lower than that of the boys was the San Diego American group. In this test the average for the Mexican boys was lower than the boys of any other group and the average of the Mexican girls lower than the girls of any other group.

BUTTONING A BELT IN THE BACK

This was the sixth test and offered a very interesting set of reactions for study. The belt was 2 inches wide and 34½ inches long, made of plain blue calico, with a button ⅝ of an inch in diameter sewed on one end with strong linen thread in such a way as to leave a shank of ⅛ of an inch. A buttonhole was on the other end of the belt, 13/16 of an inch long, through which the button passed with ease. When a child was given this test the belt was adjusted to his waist size by taking a plait in the middle and pinning with a safety pin.

The directions were: "Hold this belt out in front of you like this (illustrating the button end in the left hand and buttonhole in the right), and when I say, 'Ready, go!' I want you to put it around you and button it in the back as quickly as possible," (illustrating the action of putting it around the waist without buttoning). The belt was handed to the child with the button end in the left hand and buttonhole in the right, and the directions given.

Although, before starting the tests, the children had the explanation given them that nearly all the tests were timed "with this watch to see how fast you can do them," and in spite of the fact that this method of direction had been given for previous tests, 3 of the children, in taking this test, started to run across the room at the word "Go!" However, all the others followed the directions. If a boy had on a heavy sweater it was taken off; or if a little girl's dress were full and loose, a plait was pinned over in the front so that it would not get in the way.

Three trials were given and the shortest time-record for the three taken as the score.

The average time for each group was as follows:

	AVERAGE TIME	MEDIAN
	seconds	
Mexicans:		
Boys	6	5
Girls	9	
Sicilians:		
Boys	7	7
Girls	7	
Baltimore Americans:		
Boys	8	7.5
Girls	7	
San Diego Americans:		
Boys	11	7
Girls	8	

The Mexican boys show the shortest time record, but in the aggregate of records for both boys and girls the Sicilians are the lowest and San Diego Americans, the highest.

Some of the children buttoned the belt easily in 2 seconds, but others took a long time. One Mexican child took a minute on one trial.

The action of the hands in this test was very interesting. The child who had the shortest time records put his first finger through the buttonhole and the button in thumb and finger of the left hand when he held the belt out in front. The time scores for the 3 attempts were many times very wide apart. Sometimes the poorest score would be the last attempt. Very often the shortest score was the first or middle score. When a child was having difficulty in getting the belt buttoned, he would often open his mouth, run out his tongue or shut his mouth tight or twist his leg or foot around, nearly losing his balance. Some grunted and said, "Gee, this is hard."

The Baltimore American group and the Mexican group had the longest and the shortest time-scores. The shortest time was 2 seconds.

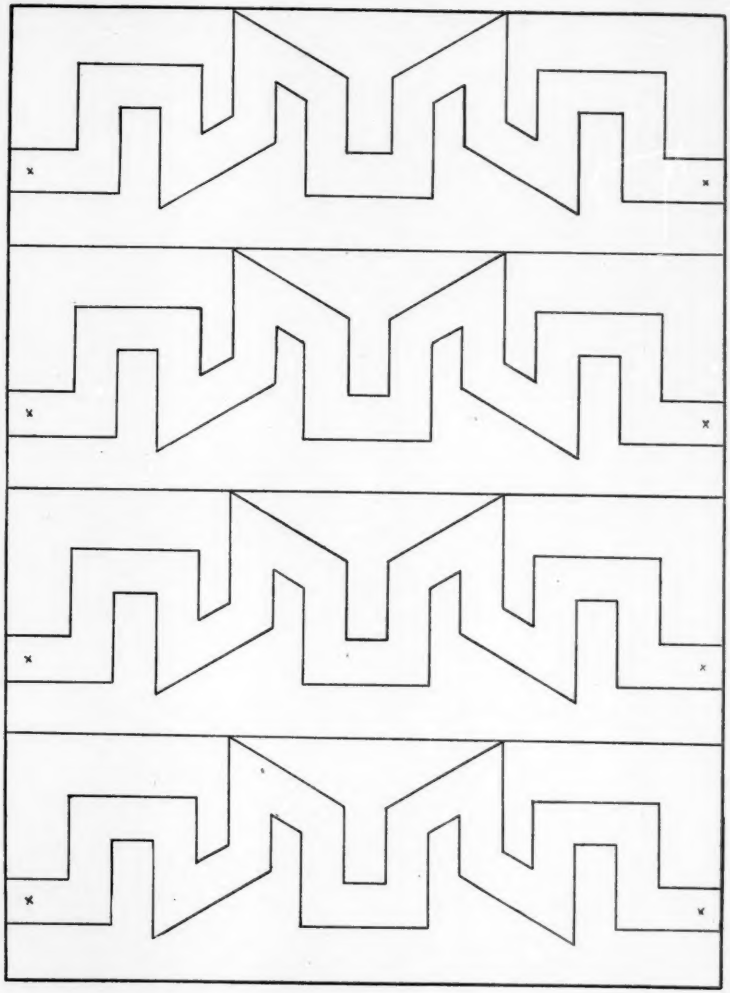
THREADING NEEDLES

The only tests in this series of eleven, requiring fairly fine motor coördinations were the threading of needles and the drawing of lines within a certain path without touching the sides of the path.

Certainly both of these tests offer very interesting study material for steadiness of hand which might form a basis, in the writer's estimation, for the study of the neural condition of the child, his general body-vigor, perhaps of his temperamental reactions also.

The 6 needles used in this test were the long-eyed needles used for wool embroidery and were number 1; the thread was linen, number 25. The threads were cut about 8 inches long and were waxed at both ends; they were re-waxed for each child and a new set of threads was cut each day, so each set was used by only 4 or 5 children.

The needles were stuck in a small cushion, and the thread laid in a row on the table in front of the child. The directions were: "Here are 6 needles and 6 threads; the threads are waxed at both ends, so they will go into the needles easily. If you spoil one end of the thread you can turn it around and use the other end. I want to see how quickly you can thread all these needles with these threads, like this." (I illustrated by threading a needle and dropping it on the table, then picked up another needle but did not thread it.) Replacing the needles and thread, I said, "Ready, go!" A stop-watch recorded the time. The length of time taken by the children in this test depended largely upon steadiness of hands, but one other element affecting the time-score was whether the needle was held in the left hand and the thread in the right or the reverse. When the needle was held in the right hand the scores show that the performance took a longer time in most instances. The left hand showed a greater amount of unsteadiness, and would sometimes give little jerks. The only exception to this observed condition was when the thread was held stationary in the left hand



JOHNSON COÖRDINATION TEST

while the needle was put on it. This method took a shorter time than when the child tried to put the thread through the eye of the needle with the left hand. When the needle was held in the left hand and the thread put through with the right, in most instances the time-record was shorter. Some of the children had very unsteady hands, sometimes a continuous tremor was noticeable and sometimes the hands would jerk. This was a test in which the left hand certainly showed poorer motor coördination than the right.

In some cases the child would fail to see that the center part of the long eye had a wider opening than the top or bottom, and would make many futile

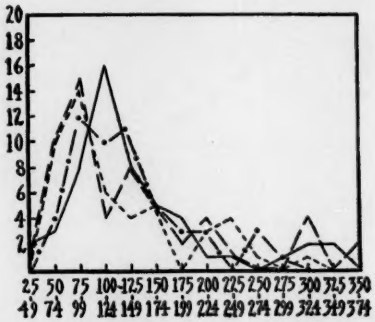


FIG. 4. RELATIVE TIME SCORES. THREADING NEEDLES

——— Mexican; ——— Italian; — — — S. D. American; —●—●— Baltimore American.

attempts to put the thread through where the opening was too small. The time was also prolonged when the child would split or bend one end of the thread and had to turn the thread around and use the other end.

The shortest time taken for this test was 29 seconds, found in the San Diego American group: in this group is also found the longest time-record, 450 seconds.

The medians for this test appear rather high. In the averages the San Diego American group makes the best record:

	AVERAGE TIME	MEDIAN
	seconds	
San Diego Americans:		
Boys	118	100
Girls	144	
Sicilians:		
Boys	118	110
Girls	155	
Mexicans:		
Boys	138	114
Girls	139	
Baltimore Americans:		
Boys	145	125
Girls	125	

MOTOR COÖRDINATION

Another coördination test was given using the blanks of the Hopkins series of coördination tests. Since they are not numbered, a blank is inserted in this test to show the size of the design. The instructions were: "I want you to draw a line in the middle of this path as fast as you can go from this point to this point. Take your pencil this way and keep your arm up from the paper." (I illustrated the method by holding my pencil vertically and drawing an imaginary line in the path all the way across.) After this method of instruction no other difficulties were encountered except in the position of holding the pencil, in order to keep the hand up from the table. This position was well maintained if the

child were watched and reminded to hold his hand up in case he forgot.

When the child's hand was in position, the signal was given "Ready, go!" The time was kept with a stop-watch.

Some of the children went slowly in order to keep in the middle of the path, others, perhaps keeping the time element in mind, went fast. Some drew the line lightly and showed very poor coördination, others whose hands appeared just as unsteady bore down heavily on the pencil giving a very steady, firm looking result. There were some who dashed along the path letting the line strike the sides again and again. When this happened in the first response, and it appeared that he had not really understood the import of the instructions, "in the middle of the path," was repeated.

The time varied from a record of 6 seconds for a line, up to 21 or 22 seconds.

The score was the sum of all the contacts with the sides of the path found in the 4 designs on the blank. The contacts recorded were from 0 to 37, and the averages were as follows:

	AVERAGE CONTACTS	MEDIAN
Baltimore Americans:		
Boys	6	6
Girls	8	
Mexicans:		
Boys	9	7
Girls	6	
San Diego Americans:		
Boys	9	8
Girls	9	
Sicilians:		
Boys	11	9
Girls	9	

Left hand

It was very noticeable that when the children were making a great effort to draw a steady line in the path, the left hand would press down heavily on the paper. Sometimes when the tension was great, in trying to draw the line quickly, the child would hold his left hand in a fist on the paper.

STRING BUTTONS

The last test given in this series was the stringing of 36 wooden button-

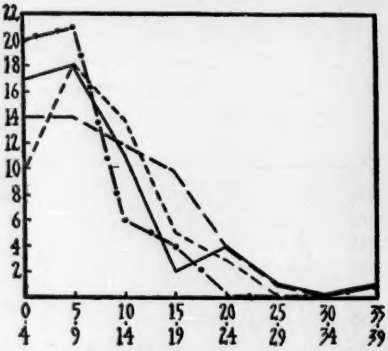


FIG. 5. RELATIVE NUMBER OF CONTACTS. MOTOR COÖRDINATION

——— Mexican; — — — Italian; — — — — S. D. American; —●—●— Baltimore American.

molds on a round shoestring. The button-molds were circular, flat on one side and convex on the other, with a hole in the center $\frac{1}{8}$ inch in diameter, so the button slipped easily on the string. The string had a knot at one end and a tin tip at the other.

The buttons were placed in a shallow pan. The child was given the tip-end of the string and the directions were: "See how fast you can string all these

buttons on this string picking up only one at a time. Ready, go!"

The children who had been in the kindergarten were very familiar with this performance and that fact doubtless had some effect upon the scores obtained. Many seemed to take the attitude of settling back and taking it easy. A number of the children chattered about home, brothers and sisters and other things until reminded to hurry. There were many others, however, who kept up the spirit of playing a game until the end, and these children made the best time-scores.

The children used many different methods of accomplishing this task. Some of the children took the string in the right hand and put the buttons on with the left hand, and others reversed this process. Some kept the bunch of strung buttons on the table and drew the string through each time as if sewing with a very long thread.

There were those who let the bunch of strung buttons lie on the floor, and as they strung the single buttons on would let those buttons drop to the floor without giving them any further attention; others would shove each button all the way down the string until it reached those already strung.

Sometimes the entire time would be lengthened by the fact that the string was held in the right hand and the bunch of buttons stung dropped to the floor on the opposite side, so the button had to be shoved down the string each time. Only a few of the children let the buttons fall wherever they chanced to, without giving them further thought. There was one method that lengthened what otherwise would have been a short-time score. The arrangement of string and bunch of buttons would be good, the child would let the buttons drop down the string giving them no more attention, once they were on the string, but every few seconds he would hold up the bunch of strung buttons for one to admire, with the remark; "See what a lot I have strung," or "It looks like a big worm." It was noticeable throughout the 3 nationalities, that

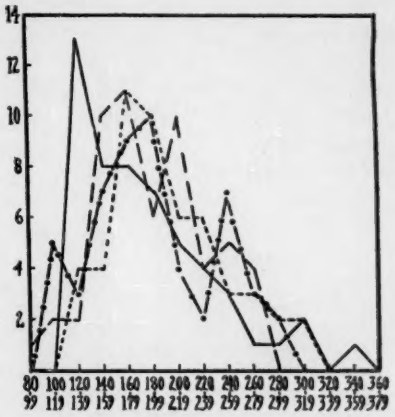


FIG. 6. RELATIVE TIME SCORES. STRINGING BUTTONS

——— Mexican; — — — Italian; — — — — S. D. American; —●—●— Baltimore American.

most of the children put the string through the button from the flat side, few of the children had a hit or miss arrangement on this particular point. Three children strung first from the convex side then from the flat side giving an entirely different appearance to the finished product. One of these children would remove a button and string from the reverse side if he chanced to put one on wrong. These

children's records were among the long-time ones.

There were a goodly number of children who retained the idea of its being a timed test throughout, and who started out with the string in the left hand, the knotted end on the floor to the left, and who put the buttons on the string rapidly with the right hand letting them drop where-ever they happened to. These were the children who made the shortest time-records.

The shortest time was made by a Sicilian child, 98 seconds; the longest time-record by a Sicilian child also, 386 seconds.

The averages are as follows:

	AVERAGE TIME	MEDIAN
	seconds	
Mexicans:		
Boys	190	169
Girls	184	
Baltimore Americans:		
Boys	191	185
Girls	188	
Sicilians:		
Boys	195	187
Girls	191	
San Diego Americans:		
Boys	206	197
Girls	199	

The above averages show that the Mexican children made a slightly better record than the children of the other groups.

SUMMARY

A comparative study of racial differences in manual dexterity has been made for Sicilian, Mexican, and native American children, the criterion of race being the birthplace of their parents. There were 2 groups of American children, one from the Atlantic coast and of favored social status, the other from the Pacific coast and of approximately same economic level as the Mexicans.

There were 212 children between the ages of four and seven tested, almost evenly distributed among the race groups. The sex differences within the groups were not so well equated.

Two forms of tests were given for obtaining an approximation of the mental level of the children in relation to standards for children of these ages. The scores for the Goodenough Drawing Test gave intelligence quotients that ranged from 70–170; these quotients were above the norm or 100 for 77 per cent of the Mexicans; 60 per cent of the Eastern Americans; 58 per cent of the Sicilians; 56 per cent of the Western Americans. For the Picture Puzzle series there are no norms. The scores compare favorably with the similar Rossolimo series and show that the group as a whole do as well as a larger group of American children. The Mexicans showed superiority in this test.

There were 8 performances in which manual dexterity played an important part. The Mexicans ranked highest in four of these tests and tied for superiority in another test. Their average rank on the series was 1.7; Baltimore Americans 2.3; Sicilians and San Diego Americans 2.8 each. For these groups the Mexicans are clearly superior in the quickness and accuracy of manipulation such as the tests involved. The conclusion can not be drawn for Latin races and not

for races in general. It does appear that certain racial groups or stocks develop early skill in manipulation greater than that of the average of American children. A control of the environments from the first months might throw light on the origin of such differences.

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An Experimental Investigation of Young Children's Interest and Expressive Behavior Responses to Single Statement, Verbal Repetition, and Ideational Repetition of Content in Animal Stories

LOIS Z. SMITH[1]

THE aim of this study was to develop an experimental technique for measuring and comparing the interest and expressive behavior responses which two-, three-, and four-year-old children give to single statement, verbal repetition, and ideational repetition of content in animal stories.

The study involved (1) the writing of stories containing these three elements, (2) the training of observers and the establishing of reliability in the use of the observer's blanks, and (3) conducting the experimental story groups.

The subjects used in the establishing of the reliability of the observers were 14 four- and five-year-old children who were attending the preschool laboratories of the Iowa Child Welfare Research Station. The subjects of the experimental story groups were 33 two-, three-, and four-year-old children. The average chronological age of the group used for establishing the reliability of the observers was 42.5 months with a standard deviation of 7.21 the average mental age 50.0 months with a standard deviation of 8.87. The average chronological age of 27 children in the main experimental group given the Stanford revision of the Binet scale was 50.9 months with a standard deviation of 6.25, and an average mental age of 59.3 with a standard deviation of 9.96. The 6 children given the Kuhlmann revision of the Binet scale had an average chronological age of 36 months with a standard deviation of 2.52 and an average mental age of 43.2 with a standard deviation of 5.46.

[1] This study was directed at the Iowa Child Welfare Research Station by Dr. Esther Van Cleave Berne. The detailed report is given in an unpublished Master's Thesis, University of Iowa, 1929. Pp. 169.

PREPARATION OF THE STORIES

The stories for the experiment were written so that they would contain certain general characteristics recommended by educators and writers of young children's stories. The follow-

ing were used as guiding principles in the construction of the stories:

1. A single incident told in chronological sequence was to be used as a plot.
2. The story must be within the child's experience.
3. The vocabulary must be understandable to children.
4. The units whether words, phrases, or sentences must be simple.
5. Young children are fond of animal stories in which the animals talk and act like people.

An incident was borrowed from a story for older children. It supplied the necessary chronological sequence of events within the experience of the young child. The story *Two Little Geese* was taken from a story called *Mrs. Goose's Rubbers* (10). The story was about a goose who had lost her rubbers and the sequence of events consisted of her attempt to find them. Some parts of the original story were incorporated in the experimental story while other parts were re-written. The other animal stories used in the experiment (*Two Little Kittens* and *Two Little Dogs*) were suggested by *Pedro's Feet* and *How Spot Found a Home* from Mitchell's *Here and Now Story Book* (9).

As a guide in choosing a vocabulary for the stories which children of these ages would understand, all of the words of each story were listed and their occurrence in children's vocabularies checked. The studies of Bateman (1, 2), Beyer (3, 4), Brandenburg (5), Bush (6), and Gale and Gale (7) were used. These studies were used by Smith (11) in constructing her vocabulary test for young children. Only those words which occurred in five or more of the vocabularies were used.

In order to make the story simple, short declarative sentences were used as often as possible. The average number of words in the sentences used in the stories was six.

The stories were written in 3 forms. Form A was told in single statements. The 2 similar characters were treated as a unit by means of a plural or compound subject. For example:

"Mr. Goose and Mrs. Goose had lost their rubbers.
They said, 'We must have them to go down town.' "

Form B was told with a verbal repetition of content. In this form each of 2 animal characters responded individually. The words used to describe the behavior of the first character were repeated in describing the behavior of the second except that the pronouns were varied in sex and number to agree with their respective antecedents and the verbs were changed in form to agree in number with their respective subjects. For example:

"Mr. Goose had lost his rubbers.
He said, 'I must have them to go down town.'
Mrs. Goose had lost her rubbers.
She said, 'I must have them to go down town.' "

In Form C the stories were characterized by ideational repetition. Each one of the two similar characters responded individually. The first character acted and spoke. The same words were used to describe this action as those used in Form A and in Form B in the repeated statements about both characters. In describing

the behavior of the second character in Form C the idea is repeated but the words are different. For example:

"Mr. Goose had lost his rubbers.
He said, 'I must have them to go down town.'
Mrs. Goose's rubbers were lost. 'I cannot go to the store without them,' she said."

From observation of story groups in the preschool laboratories it was decided that a story requiring three minutes would come well within the period during which even the youngest child could give attention to the story. The reading of Form A required 1½ minutes, and Form B and Form C each required 3 minutes. The stories were written in one-half minute units so that each item of expressive behavior or interest could be checked on the basis of occurrence within half minutes. Each unit of a story was typed in the story book on the space between two leaves so that turning a page indicated to the observers the end of a half minute unit.

Three comparable stories were written for the experiment, one for use as a trial story in establishing reliability; the others for use in the experiment proper. The story *Two Little Geese* is reported on page 235.

TRAINING OF THE STORY-TELLER

The story-teller made special preparation for the telling of the stories in order that the telling would be as uniform as possible. Each form of each story was memorized. A careful study was made of the enunciation, pronunciation, expression, and voice used in telling the stories. The story was timed so that the story-teller always took the same amount of time in telling it. Persons trained in telling children's stories criticized the story-teller's presentation of the story. A small story book which lay on the lap of the story-teller served as a guide and aided in maintaining uniformity.

The personality of the story-teller as manifested by dramatic pause, voice quality, inflection, and facial expression was evidenced only enough to insure the children's interest and was made uniform for all forms of stories.

At the end of the experiment the story-teller asked the observers to report on her uniformity in manner and time of presentation of the stories. The following reports were given:

OBSERVER X	OBSERVER Y	OBSERVER Z
Time		
Very uniform for each form	Seemed to be the same for the forms that were alike	Uniform
Presentation		
Differed very little	Surprisingly uniform	Uniform. Fatigue may have made a little difference in last of the six stories given in one day

TRAINING THE OBSERVERS AND ESTABLISHING THE RELIABILITY OF THE OBSERVER'S BLANK

Following the preparation of the stories, the next problem was the development of a technique for recording the interest and expressive behavior of the children in the story

TWO LITTLE GEESE

FORM A	FORM B	FORM C
Mr. and Mrs. Goose could not find their red rubbers.	Mr. Goose could not find his red rubbers.	Mr. Goose could not find his red rubbers.
"We need them to go down town," they said.	"I need them to go down town," he said.	He said, "I need them to go down town."
They had peeked into every corner of the little dark closet under the stairs.	Mrs. Goose could not find her red rubbers.	Mrs. Goose's rubbers were lost.
Their red rubbers were not there.	"I need them to go down town," she said.	She said, "I cannot go to the store without them."
Mr. and Mrs. Goose looked under the bed.	Mr. Goose peeked into every corner of the little dark closet under the stairs.	Mr. Goose peeked into every corner of the little dark closet under the stairs.
They opened the ice box and looked into it.	His red rubbers were not there.	His red rubbers were not there.
Their red rubbers were lost.	Mrs. Goose peeked into every corner of the little dark closet under the stairs.	From top to bottom of the dark closet Mrs. Goose looked for her red rubbers.
	Her red rubbers were not there.	She did not find them.
Mr. and Mrs. Goose rolled up the rug and looked under it.	Mr. Goose looked under the bed.	Mr. Goose looked under the bed.
They saw no red rubbers.	Mrs. Goose looked under the bed.	Down under the bed Mrs. Goose crawled to look.
They heard the rain drops hitting the roof of their house.	Mr. Goose opened the ice box and looked into it.	Mr. Goose opened the ice box and looked into it. His red rubbers were lost.
They put on their coats and hats.	His red rubbers were lost.	Mrs. Goose could not find her rubbers in the ice box. They were gone.
They picked up their baskets and very green umbrellas.	Mrs. Goose opened the ice box and looked into it.	
They went out the door.	Her red rubbers were lost.	
Mr. and Mrs. Goose closed the door.		
They opened their big green umbrellas.	Mr. Goose rolled up the rug and looked under it. He saw no red rubbers.	Mr. Goose rolled up the rug and looked under it. He saw no red rubbers.
Plop! Four big somethings fell on their heads nearly knocking their hats off.	Mrs. Goose rolled up the rug and looked under it. She saw no red rubbers.	Mrs. Goose's red rubbers were not under the rug. She lifted it to look.
Mr. and Mrs. Goose looked to see what had dropped.	Mr. Goose heard the rain drops hitting the roof of the house.	Mr. Goose heard the rain drops hitting the roof of his house.
There were their red rubbers.	Mrs. Goose heard the rain drops hitting the roof of the house.	The rain was falling on the top of the house. Mrs. Goose listened.
They put on their red rubbers.		
They walked in the water on their way down town.		

TWO LITTLE GEESE—*Concluded*

FORM A	FORM B	FORM C
	Mr. Goose put on his coat and hat. Mrs. Goose put on her coat and hat. Mr. Goose picked up his basket and green umbrella. Mrs. Goose picked up her basket and green umbrella. Mr. Goose went out on the porch. Mr. Goose closed the door. Mrs. Goose went out on the porch. Mrs. Goose closed the door.	Mr. Goose put on his coat and hat. Mrs. Goose had her wraps on. Mr. Goose picked up his basket and green umbrella. Mrs. Goose was carrying her basket and green umbrella. Mr. Goose went out on the porch. Mr. Goose closed the door. Mrs. Goose shut the door behind her.
	Mr. Goose opened his big green umbrella. Plop! Two big somethings fell on his head. They nearly knocked his hat off. Mrs. Goose opened her big green umbrella. Plop! Two big somethings fell on her head. They nearly knocked her hat off. Mr. Goose looked to see what had dropped. There were his little red rubbers.	Mr. Goose opened his big green umbrella. Plop! Two big somethings fell on his head. They nearly knocked his hat off. Mrs. Goose put up her umbrella. Out of it dropped something that put her bonnet over one of her eyes. Mr. Goose looked to see what had dropped. There were his little red rubbers.
	Mrs. Goose looked to see what had dropped. There were her little red rubbers. Mr. Goose put on his red rubbers. He walked through the water on his way down town. Mrs. Goose put on her red rubbers. She walked through the water on her way down town.	Mrs. Goose saw that her two little red rubbers had fallen out of her umbrella. Mr. Goose put on his red rubbers. He walked in the water on his way down town. With her red rubbers on her little feet, Mrs. Goose went through the rain to the store.

situations. The observer's blank as used in this study lists 5 types of expressive behavior (1) laughs, (2) smiles, (3) claps hands, nods approval, etc. (4) annoyed, (5) neutral; and 3 types of interest (1) watches, (2) any combination of watching or not watching, (3) does not watch.

The experimenter in weighing the observations of expressive behavior assumed that greater amounts of expressiveness in enjoyment or disapproval of the story should be given the higher positive or negative scores while less expressiveness should be given scores falling between the extremes. Thus the scale of expressive behavior ranges from −1 to 3 with 1 as the midpoint for neutral expressiveness.

Expressive Behavior Items	*Score*
1. Laughs—the child's amusement is expressed by a chuckle, giggle, or snort.....	3
2. Smiles—the child's mouth is drawn up into a smile.....	3
3. Claps hands, or nods approval...	3
4. Annoyed—the child scowls or watches the door.....	2
5. There is an absence of 1, 2, 3, and 4. The child has a neutral expression.....	1

A scale for interest values was chosen which ranged from 0 to 2. The score of 1 served as a midpoint from which differences were judged. The following are definitions of interest items:

Interest Items	*Score*
1. Watches—the child's eyes are focused on the story-teller all of the time except possibly for a glance.....	2
2. Any variation between 1 and 3...	1
3. Does not watch—his eyes are focused on other things—not on the story-teller except for a possible glance.....	0

All three of the observers were college graduates and two were graduate students with special training in child psychology. Twelve hours during a period of two weeks were spent in training the observers for the experiment. This period of training was characterized by the experimenter's telling of stories to groups of children and the observers checking on the observation blank the behavior responses of the same 2 children. Disagreements were noted and discussed. Definitions were agreed upon and examples of the types of behavior cited. This procedure was repeated until the number of disagreements became so few as to indicate that the observers were sufficiently trained.

The agreement of the observers is shown by correlations between observers X, Y, and Z.

RATERS	r	P.E.
Expressive behavior		
X with Y	.98	±.005
Y with Z	.98	±.005
X with Z	.98	±.005
Average.....	.98	±.005
Interest		
X with Z	.87	±.027
Y with Z	.95	±.022
X with Y	.99	±.005
Average.....	.94	±.017

EXPERIMENTAL STORY GROUPS

The next problem of the study was the division of the two-, three-, and four-year-old children into story groups. Since it was hoped that the influence arising from the individual reactions of the children would be simi-

lar for all the groups, the 6 groups were made fairly comparable on the basis of mental age and extroversion-introversion ratings (8). Thirty-three children served as subjects.

One story was presented to each of the experimental story groups previous to the experiment. This was done for the training of the observers and for the purpose of permitting the children to become accustomed to the experimental story group situation. The story, *Two Little Kittens* was used for establishing reliability, and the stories *Two Little Dogs* and *Two Little Geese* were used in the experiment proper.

The experimental story groups were conducted each week over a period of 6 weeks. The order was arranged so that 3 of the groups received the *Two Little Geese* story first and 3 of the groups the *Two Little Dogs* story first. The forms of each story were presented in 3 different orders so that the influence of position in the series was equalized for each form. The order in which the stories were presented and the record of the actual time taken for the telling of each story are given in table 1.

The first time the child was taken for a story group, the teacher in charge of the preschool group said, "Mrs. .... would like to tell you a story." The experimenter said nothing to the children, merely waited for them at the door. The 6 children were brought into the testing room and seated in little chairs grouped around the story-teller. The 3 observers sat facing the children in positions closest to the children whom they were to observe. The story-teller, began by saying, "I am Mrs. .... I am going to tell you a story about (giving the name of the story)." She started a stop-watch which she had in the pocket of her smock at the instant she began the story. At the completion of the reading material she had between the pages of the small green-covered story book on her lap, she turned the page. This movement was a signal to the observers that a half minute had elapsed. At the close of the story, the stop-watch was stopped. The experimenter said, "That is all. Perhaps some other day I shall tell you another story." The length of time used in telling the story was recorded and the children were taken back to play.

ANALYSIS OF THE EXPERIMENTAL RESULTS

The interest and expressive behavior scores and the means, standard deviations, and coefficients of variation of the score from Forms A, B, and C of the *Two Little Geese* story and of the *Two Little Dogs* story are shown in tables 2 and 3.

In order to compare the variability of the interest scores and expressive behavior scores from the 3 forms of the 2 stories the coefficients of variation of the scores from the forms were computed in terms of the means and standard deviations of each form. Examination of these percents show that the scores from Form B, characterized by verbal repetition, were less variable than those from the other 2 forms and that scores from Form A, characterized by single statement, were more variable than those from the other 2 forms. The scores from Forms B and C show about equal variability.

TABLE 1

Order of presentation and time record of the stories

WEEK	GROUP	STORY	FORM	TIME RECORD OF STORIES	
				minutes	*seconds*
First	I	Two Little Geese	A	1	30
	II	Two Little Geese	B	3	
	III	Two Little Geese	C	3	
	IV	Two Little Dogs	A	1	30
	V	Two Little Dogs	B	3	
	VI	Two Little Dogs	C	3	
Second	I	Two Little Geese	B	3	
	II	Two Little Geese	C	3	
	III	Two Little Geese	A	1	30
	IV	Two Little Dogs	B	3	
	V	Two Little Dogs	C	2	57
	VI	Two Little Dogs	A	1	29
Third	I	Two Little Geese	C	3	
	II	Two Little Geese	A	1	30
	III	Two Little Geese	B	3	
	IV	Two Little Dogs	C	3	
	V	Two Little Dogs	A	1	30
	VI	Two Little Dogs	B	3	
Fourth	I	Two Little Dogs	A	1	32
	II	Two Little Dogs	B	3	2
	III	Two Little Dogs	C	3	
	IV	Two Little Geese	A	1	30
	V	Two Little Geese	B	3	
	VI	Two Little Geese	C	3	2
Fifth	I	Two Little Dogs	B	3	
	II	Two Little Dogs	C	3	
	III	Two Little Dogs	A	1	28
	IV	Two Little Geese	B	3	
	V	Two Little Geese	C	3	
	VI	Two Little Geese	A	1	30
Sixth	I	Two Little Dogs	C	3	
	II	Two Little Dogs	A	1	30
	III	Two Little Dogs	B	3	
	IV	Two Little Geese	C	3	
	V	Two Little Geese	A	1	30
	VI	Two Little Geese	B	3	2

TABLE 2

Interest scores from Forms A, B, and C of the Two Little Geese and the Two Little Dogs stories

CHILD	STORY					
	Two Little Geese			Two Little Dogs		
	Form					
	A	B	C	A	B	C
M469	6	12	10	6	12	10
F320	6	12	10	6	12	10
F415	4	11	6	5	11	8
F427	0	9	4	3	10	5
M491	5	12	5	5	12	8
F483	3	8	0	3	8	6
M468	6	12	10	6	12	10
F362	6	12	10	6	12	10
M419	6	12	10	6	12	10
F477	4	12	8	4	12	8
M431	6	12	7	6	12	7
M272	6	12	10	6	12	10
F473	6	12	7	6	12	7
F391	6	12	9	6	12	9
M450	6	12	9	6	12	9
M494	6	12	9	6	12	9
M474	6	12	9	6	12	9
F498	6	12	12	6	12	12
F401	6	11	12	6	11	12
F306	5	12	10	5	12	10
M370	6	12	10	6	12	10
F380	6	12	10	6	12	10
F463	6	12	12	6	12	12
F471	6	12	10	6	12	10
M263	6	12	12	6	12	12
F485	5	12	10	5	12	10
M475	6	12	12	6	12	12
F389	6	12	12	6	12	12
M355	6	12	9	6	12	9
F351	3	12	12	3	12	12
M279	4	12	12	4	12	12
F369	6	12	11	6	12	11
M464	6	12	11	6	12	11
Mean.....	5.36	11.73	9.39	5.67	11.76	9.76
S.D.....	1.30	.71	2.28	.84	.71	1.95
V.....	24.06	6.05	24.28	14.81	6.04	19.97

In order to discover the consistency of the children's interest and expressive behavior responses to the corresponding forms of the 2 stories, interest and expressive behavior scores from Forms A, B, and C of the *Two Little Dogs* story were correlated with interest and expressive behavior scores

TABLE 3

Expressive behavior scores from Forms A, B, and C of the Two Little Geese and the Two Little Dogs stories

CHILD	STORY					
	Two Little Geese			Two Little Dogs		
	Form					
	A	B	C	A	B	C
M469	6	12	9	6	12	9
F320	6	12	9	6	12	9
F415	5	10	2	5	10	3
F427	1	7	3	4	9	3
M491	5	9	3	6	9	5
F483	2	7	0	4	7	1
M468	3	10	6	3	10	6
F372	3	10	8	3	10	8
M419	3	8	6	3	8	6
F477	5	12	6	5	12	6
M431	5	15	10	5	15	10
M272	3	10	12	3	10	12
F473	9	12	6	9	12	6
F391	3	12	6	3	12	6
M450	3	14	8	3	14	8
M494	3	12	8	3	12	8
M474	3	10	8	3	10	8
F498	3	10	8	3	10	8
F401	3	10	6	3	10	6
F306	5	12	10	5	12	10
M370	10	6	10	10	6	10
F380	7	6	10	7	6	10
F463	3	10	9	3	10	9
F471	3	8	10	3	8	10
M263	3	6	8	3	6	8
M485	3	12	6	3	12	7
M475	3	12	12	3	12	12
F389	5	16	12	5	16	12
M355	7	19	11	7	19	11
F351	5	18	10	5	18	10
M279	5	20	12	5	20	12
F369	3	11	12	3	11	12
M464	3	11	12	3	11	12
Mean.....	4.21	11.3	8.12	4.48	11.24	8.27
S.D.....	1.93	3.46	2.99	1.80	3.37	1.63
V.....	45.80	30.62	36.82	40.18	29.98	29.71

from Forms A, B, and C of the *Two Little Geese* story.

These correlations were uniformly positive and high, ranging from .96 $\pm$.002 to .99 $\pm$.002, indicating that the agreement between the interest

scores on one form of one story and the same form of the other story was close. Since the correlations between the 2 stories were high, only the results of the 3 forms of the *Two Little Dogs* story were used to determine the amount of agreement among the interest scores of the children from the different forms.

These correlations indicated that between interest scores from the 3 forms there was a positive relationship between Forms A and C (.47 ±.092). The expressive behavior correlations ranging from .28 ±.108 to .32 ±.105 indicated that there was probably no agreement between th9 expressive behavior scores from stories characterized by single statement, verbal repetition, and ideational repetition of content.

Table 4 gives the means and standard deviations of the interest scores and the expressive behavior scores from Forms A and B, Forms A and C, Forms B and C, arranged for comparison of the different forms of the *Two Little Dogs* story. It should be recalled that the interest and expressive behavior scores from Form A were not directly comparable to the interest and expressive behavior scores of Forms B and C in time since Form A was only one-half the length of Form B or C. For this reason the Form A scores in this comparison were doubled to make them directly comparable. In order to discover whether there were significant differences between the means of the 3 forms the probable errors of the differences between the means and the ratio of the difference between the means and probable errors of the difference were computed.

The mean of the interest scores from Form A was compared with the mean of the interest score from Form C and the results indicated a significant difference in favor of the mean of the interest scores from Form A. The ratio of the difference was 5.24 in favor of Form A. This comparison made on the theory that both stories were 3 minutes in length, indicated that Form A, with a single statement of content, was more interesting than Form C, with ideational repetition of content. A comparison of the interest scores from Form B and Form C shows a true difference between the means; the ratio of the difference between the means to the probable error of the difference being 8.19 indicating that Form B which is characterized by verbal repetition of content was much more interesting than Form C, characterized by ideational repetition of content.

Since it was not known that the length of the three minute story did not decrease the interest or expressive behavior scores from Form B and from Form C, the means of the scores from the first half of Form B and of Form C were compared with Form A. In comparison of the mean of the interest scores from Form A and the mean of the scores from the first 3 half-minute periods of Form B, the ratio of the difference between the means was found to be 4.13. This comparison indicated that the interest in the longer story characterized by verbal repetition, was greater during the first 3 half-minute periods than in the first 3 periods of Form A, characterized by single statement. In a comparison of the mean of the interest scores from Form A and Form C no

significant difference was found; the ratio of the difference being 3.00.

There was a significant difference of 5.66 between the means of the expressive behavior scores from Form B and Form A. The ratio indicating that the expressive behavior of the 33 children in response to Form B with verbal repetition, was significantly greater than that arising from Form A, with its single statement of content. Comparing expressive behavior means of the scores from Form A and Form C for significant differences the ratio of the difference was found to be 1.49. These data show that there was no

TABLE 4

Significant differences between Form A and Form B, Form A and Form C, and Form B and Form C

FORM	MEAN	STANDARD DEVIATION	PROBABLE ERROR	PROBABLE ERROR OF DIFFERENCE	ACTUAL DIFFERENCE OF MEANS	RATIO
Interest						
A†	11.34	1.68	±.196	.224	.42	1.88
B	11.76	.71	±.084			
A	5.67	.84	±.006	.083	.33	4.13
B*	6.00	.00	±.000			
A†	11.34	1.68	±.196	.301	1.58	5.24
C	9.76	1.95	±.229			
A	5.67	.84	±.002	.069	.21	3.00
C*	5.88	.00	±.022			
B	11.76	.71	±.084	.244	2.00	8.19
C	9.76	1.95	±.229			
Expressive behavior						
A†	8.96	3.60	±.422	.402	2.28	5.66
B	11.24	3.37	±.396			
A	4.48	1.80	±.103	.243	1.48	6.31
B*	5.96	.00	±.115			
A†	8.96	3.60	±.422	.463	.69	1.49
C	8.27	1.63	±.192			
A	4.48	1.80	±.103	.173	.52	3.05
C*	5.00	1.95	±.143			
B	11.24	3.37	±.396	.375	2.97	7.92
C	8.27	1.63	±.192			

* The scores for only the first half of this story were used in the correlation.

† The scores for this story were multiplied by two before correlating.

significant difference between the expressive behavior arising from single statement of content in Form A and ideational repetition of content in form C. Computing the differences between the expressive behavior scores from Form B and Form C, a ratio of the difference of 7.92 was found in favor of Form B. This would indicate that Form B, characterized by verbal repetition, produces greater expressive behavior than Form C, characterized by ideational repetition.

For expressive behavior as for interest, the mean of the scores from Form A were compared with the means of the first half of Forms B and C. Comparison of the mean of the expressive behavior scores from Form A and the mean of the scores from the first 3 half-minute units of Form B gave 6.31 as the ratio of the difference in favor of Form B indicating that the mean of the scores from the first 3 periods of Form B, distinguished by verbal repetition, were significantly higher than the mean of the scores from the 3 time units of Form A, distinguished by single statement of content. In comparing the mean of the scores from Form A with that from the first 3 time units of Form C, the ratio of the difference was 3.05 in favor of the longer story, indicating that the mean of the expressive behavior scores from the first half of the longer story characterized by ideational repetition of content were probably not significantly greater than the mean of the scores from the story characterized by single statement of content.

In order to determine the relation between the interest scores from Forms A, B, and C of the *Two Little Dogs* story and the Marston introversion-extroversion ratings (8) 33 correlations were calculated. These correlations indicated no relationship between interest except with the possibility of expressive behavior on Form A and introversion-extroversion ratings.

The interest scores from Form A, Form B, and Form C and the chronological age of 33 children were correlated. The correlations showed that there was no relationship (.05 $\pm$. 117) between age and interest in the story (Form A) characterized by single statement of content and very little relationship (.28 $\pm$.108), between chronological age and interest in the story (Form B) characterized by verbal repetition and chronological age. However, the positive correlation .62$\pm$.072, between the interest scores from Form C and chronological age was significant and fairly high indicating that in general the children who were most interested in Form C characterized by ideational repetition, were the older children chronologically.

An insignificant correlation (.17 $\pm$ .114) was found between expressive behavior from Form A and chronological age and a low correlation between expressive behavior from Form B (.32 $\pm$.105) and chronological age. The positive correlation of .67 $\pm$.065 between expressive behavior scores from Form C and chronological age was fairly high and significant. These 3 correlations indicated that chronological age was not related to expressive behavior in stories characterized by single statement or verbal repetition of content but that it was related to expressive behavior in stories char-

acterized by ideational repetition of content. In general, as the age of the children increased expressive behavior responses to ideational repetition also increased.

The interest scores from Form A, Form B, and Form C and the Stanford-Binet mental age scores of 27 children were correlated.

According to Fisher[2] a correlation for 27 cases cannot be considered significant unless the ratio of the correlation to its standard error of estimate is at least 2.779. The ratios of the correlations to their standard errors showed no relationship between interest scores arising from single statement, verbal repetition, and ideational repetition of content and mental age; and no relationship between expressive behavior scores arising from Form A, with single statement of content and from Form B, with verbal repetition of content and mental age; however, the partial correlation between expressive behavior scores and mental age, with chronological age constant, approached significance ($r = .381$; $t = 2.019$) while the correlation between expressive behavior and chronological age with mental age constant was not significant ($r = .164$; $t = .940$). The correlation between mental age and chronological age, with expressive behavior constant was .494, t being 2.783. It appears from these correlations that possibly the expressive behavior arising from the ideational repetition of Form C may be related to those factors peculiar to mental age rather than to those factors peculiar to chronological age.

[2] Fisher, R. A.: Statistical methods for research workers. 2nd. ed. rev. and enl. Edinburgh: Oliver & Boyd, 1928. Pp. xi, 269 (p. 159).

Fisher for small numbers of cases, determines t, the ratio of a correlation to its standard error of estimate, according to the following formula:

$$t = \frac{r}{\sqrt{1 - r^2}} \cdot \sqrt{n' - 2}$$

in which r is the correlation obtained, n' the number of pairs of observations on which the correlation is based and n which equals $n' - 2$ is the number used with t in discovering p, or probability. A table for t reveals with what probability such a correlation should arise, by random sampling, from an uncorrelated population. If the probability is .01, (i.e. one chance in 100) Fisher regards the correlation as significant. The distribution in random samples of partial correlation coefficients is derived from that of total correlation coefficients by deduction from the number of the sample the number of variates eliminated.

SUMMARY AND CONCLUSIONS

The aim of the present study was to develop an experimental technique for measuring and comparing the interest and expressive behavior responses which two-, three-, and four-year-old children derive from single statement, verbal repetition, and ideational repetition of content in animal stories. The solution of the problems arising in the study required 3 procedures; the first of which was the writing of 3 stories containing single statement, verbal repetition, and ideational repetition of content; second, the training of observers and establishing of reliability on the use of the observers blank; third, the conducting of the experimental story groups.

The 3 observers were trained and their reliability was established on the use of an observer's blank.

The subjects of the investigation were 33 children who were enrolled

in the preschool laboratories of the Iowa Child Welfare Research Station. These subjects were arranged in 6 comparable groups to which the forms of the stories were presented in 3 different orders. The specific findings of this study are:

1. The observation and observer's blank used in this experiment are a reliable technique for the measurement and comparison of the interest and expressive behavior responses of two-, three- and four-year-old children to single statement, verbal repetition, and ideational repetition of content in animal stories. This is revealed by the correlation of $.96 \pm .011$ which is the average of 6 correlations between scores made by the 3 observers on the same children.

2. The coefficients of variability of the interest and expressive behavior scores from all forms of the *Two Little Dogs* story were slightly higher than those from the corresponding forms of the *Two Little Geese* story.

3. The significant differences between the interest of the 33 children in Form A, Form B, and Form C of the *Two Little Dogs* story as shown by the means of their scores seemed to indicate that Forms B, with verbal repetition of content, was more interesting than either Form A with single statement or Form C with ideational repetition of content. The significant differences between the means of scores for expressive behavior showed a significantly greater response to Form B, characterized by verbal repetition of content, than to Form A or Form C.

4. There appeared to be no relationship between chronological age and the children's interest and expressive behavior responses to Form A and Form B. However, there was a positive relationship between Form C, characterized by ideational repetition of content, and chronological age. This meant that the older children were more interested and showed greater expressive responses to Form C of the stories than did the younger children.

5. Although the mental age of the 33 children showed no relationship to the expressive behavior scores made on Form A and Form B of the story, there was a positive relationship between the children's expressive behavior scores from Form C of the story and mental age. This relationship indicated that the mentally older children tended to give the more expressive responses to Form C which was characterized by ideational repetition of content than did the younger children.

6. A partial correlation between expressive behavior scores from Form C and mental age with chronological age held constant approached significance while a correlation between expressive behavior scores from Form C and chronological age with mental age held constant did not approach significance. These correlations indicate that the expressive behavior arising from the ideational repetition in Form C may have been related to those factors peculiar to mental age, and not to those factors peculiar to chronological age.

7. Correlations of the interest scores from the different forms of the *Two Little Dogs* story showed a positive relationship between only Form A, single statement, and Form C, ideational repetition of content. This showed that those children who were

interested in stories which were characterized by single statement also tended to be interested in stories which were characterized by ideational repetition of content.

8. Correlations revealed no relationship between the expressive behavior responses on these 3 forms of the stories, single statement, verbal repetition, and ideational repetition of content.

9. There was no relationship between extroversion rating and the children's interest and expressive behavior responses to the forms of the story.

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Play Activities of Children in the First Six Grades

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IN connection with the collection of certain other data,[1] children in grades 1 to 6 in certain Minneapolis schools were asked to write in 10 spaces the names of outdoor games which they had played more than once during the previous year, to underline the games they had played most often (as baseball, tag, etc.) and farther down on the same page to make the same record for indoor games (as basketball and authors, etc.). When the material came to be worked up, it seemed unwise to use the underlinings made by the children because it was clear that certain children misunderstood this part of the directions, some underlining all games and some none. The data reported in this paper are, therefore, based merely upon the games listed. If more than ten games were recorded by any child, only the first ten were used.

From table 1 it appears that both boys and girls are consistent in listing fewer games for indoor than for outdoor play. This may mean nothing save that since the outdoor games were always recorded first the child's interest or imagination gave out before the end. It probably, however, is significant since there is some evidence of less community of interest about indoor games than about those played out of doors.

An attempt was made to classify the games which the children listed. Some games named were, of course, impossible to locate; some were not identified because we were unable to untangle the spelling; still other games seemed to be individual plays which for one or two children had become sufficiently formalized to be given a name but which were listed in none of the common books on games. The classification which was finally adopted divided the games into the following classes:

1. Catching, throwing, kicking games (such as baseball, basketball, duck on the rock, marbles, jacks, croquet)
2. Chasing, fleeing games (such as three deep, blindman's buff, king of the hill, pom pom pull away, fire on the mountain, drop the handkerchief)
3. Hiding, seeking games (such as cop and robber, hide and seek, hide the thimble, button button, cowboy and Indian)
4. Jumping, hopping games (such as hop scotch, leap frog, jump rope)
5. Folk dances, singing ring games (such as Soldier Boy, London Bridge,

[1] The data reported in this paper were collected by Mr. Harry S. Clark in connection with work done for a course in Teaching Social Sciences under Prof. A. C. Krey of the University of Minnesota.

Farmer in the Dell, Lazy Mary, Here We Go Round the Mulberry Bush)

6. Informal dramatization (such as house, store, office, dolls, school, show)
7. Following directions (such as do this do that, Simon says, follow the leader)
8. Table games (such as Old maid, Snap, Uncle Wiggly, Parchesi)
9. Very active play which may be individual (such as sliding, skating, swimming)
10. Rather inactive play which may be individual (such as painting, sewing, radio)
11. Group games of the guessing type (such as buzz, telephone, lead man, silent circle, beast bird or fish)

steadily more marked. Of all other games in this group, baseball stands out preëminently. The girls show an increase in interest in the catching-throwing with advancing age but they never equal the interest which the boys show in this type of game. There is little difference in the popularity of the chasing-fleeing games for the two sexes for the ages considered.

With both boys and girls the popularity of the singing-ring games (type V) decreases steadily from age six on. These games are more popular with girls than with boys and the games continue to be played at higher ages than in the case of boys. The hiding

TABLE 1

Mean number of games listed by children in various grades

GRADE	NUMBER OF CASES		MEAN NUMBER OF OUTDOOR GAMES		MEAN NUMBER OF INDOOR GAMES	
	Boys	Girls	Boys	Girls	Boys	Girls
1	16	27	8.3	9.1	7.8	8.5
2	75	71	8.6	8.6	6.2	7.5
3	175	173	8.8	8.5	7.3	7.6
4	153	150	9.0	9.1	6.6	7.5
5	152	130	9.1	9.5	7.8	8.2
6	167	134	8.5	9.3	8.0	7.9

Table 2 shows the classification of all games which we could identify. From this table it is clear that among outdoor games the only types that make up any appreciable percentage of the total number fall in the first five types. For boys the preference lies clearly in the catching-throwing games (type I) and the chasing-fleeing games (type II). For ages six through nine, the boys show some preference for the chasing-fleeing games over the catching-throwing games but from age ten on the popularity of the catching-throwing games becomes and seeking games keep at about the same level with both sexes over a long period of years. Girls show a definitely greater interest in jumping-hopping games (type IV) than do the boys. Although this interest is at no age great enough to make up more than 10 per cent of the total number of games listed, still it never with the girls falls as low as the highest percentage in the case of the boys. Informal dramatization, although never very high for either sex, shows a decrease with advancing age. Games of the type of "do this, do that" reach

a rather low maximum for both sexes at age seven and then gradually decrease. The same trends of interest are shown when we divide the children by their grade in school rather than by their chronological age.

When we consider indoor games, we get the distribution of table 3.

TABLE 2

Outdoor games—percentages of children of different ages playing different types of games

AGE	TYPE											NUMBER OF CASES
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	
	Boys											
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	
6	23	33	22	1	10	5	0	0	5	0	0	105
7	20	51	11	3	6	1	5	0	3	0	1	335
8	27	45	16	3	3	2	3	0	1	0	1	943
9	31	43	19	2	1	1	1	0	1	0	1	1,323
10	39	38	15	2	1	1	1	0	2	0	2	1,360
11	49	29	15	2	0	0	1	0	3	1	1	1,123
12	39	36	17	3	0	1	1	0	3	0	1	348
13 and over	51	30	11	4	0	0	1	0	3	1	0	331
	Girls											
6	13	37	11	10	21	5	0	0	2	0	0	168
7	15	48	12	6	7	2	4	0	3	0	2	417
8	19	38	15	10	6	5	3	0	3	0	2	1,032
9	24	41	14	8	3	3	2	0	2	0	2	1,300
10	28	41	14	7	1	1	3	0	1	0	3	1,036
11	34	32	16	9	1	1	1	0	2	0	3	978
12	33	34	14	8	2	1	1	0	3	0	3	462
13 and over	33	33	19	10	2	0	1	0	0	0	1	213

This table is probably less accurate than the tables on the outdoor games. It seemed evident from working with the records that some children failed to distinguish between indoor and outdoor games, but since it is possible to play many games either outdoors or inside if we consider the possibilities of a gymnasium, since there is a table croquet game as well as the usual croquet, and since there is an outdoor game of "500" as well as a card game by that name, it was deemed unwise to make any attempt to discard a game listed in the belief that the child had recorded the game in the wrong place.

When we compare boys and girls on indoor games we find the popularity of catching-throwing games among the boys not nearly so marked as was the case in the outdoor games. In fact, throughout the list there seems to be much closer agreement on the games played by the two sexes except for informal dramatization (type VI) which

is more popular with the girls and the "active play sometimes individual" (type IX) which is more popular with the boys. As might be expected, both sexes show smaller percentages in the catching-throwing and the chasing-fleeing games and much larger percentages in the table games in indoor than in outdoor games.

children in grades above the sixth, it meant that the superior twelve-year-olds would not be included. The seven-year-olds, although few in number, probably represent the children of that age who are in school (exclusive of the kindergarten)

From this array of favorite games it is clear that baseball attains a popu-

TABLE 3

Indoor games—distribution of percentages by age

AGE	TYPE											NUMBER OF CASES
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	
Boys												
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	
6	5	31	11	0	28	13	2	3	1	5	0	96
7	6	18	16	1	26	3	3	24	0	2	0	232
8	13	16	14	1	12	8	2	26	2	4	2	708
9	17	16	12	1	2	6	0	38	2	3	3	951
10	24	13	11	1	3	4	2	35	2	3	2	986
11	26	10	9	1	1	2	2	37	8	1	2	909
12	23	9	12	1	0	3	1	35	11	2	3	333
13 and over	24	5	10	3	2	1	0	39	12	3	2	254
Girls												
6	8	31	15	1	34	10	0	1	1	0	0	137
7	10	16	13	1	27	10	2	17	2	2	0	336
8	10	20	19	0	8	16	2	16	1	3	4	849
9	11	15	11	1	3	18	1	31	1	2	5	1,046
10	16	17	11	0	4	10	1	33	1	2	6	792
11	21	15	11	1	2	10	1	30	1	1	7	753
12	17	11	13	0	3	8	2	38	1	1	7	342
13 and over	20	13	16	1	4	7	1	32	1	2	3	152

When we consider the individual games (not the types of plays) which are played by most children, we may select the five favorite outdoor (table 4) and the five favorite indoor (table 5) games for ages seven through eleven. There were comparatively few records on children over eleven and since these records included no

larity with boys that is equalled only by the popularity of jacks among the girls. Both boys and girls retain their interest in tag games throughout the ages included. Tag itself is listed among the five most popular games for each sex and every age. Washington poke (a form of tag) appears in seven out of the ten lists and stoop

TABLE 4

Favorite outdoor games of children of different ages

In order of preference

BOYS	GIRLS
Age 7	
Hide and seek	Hide and seek
Washington poke	Tag
Baseball	Stillwater
*[Tag	Stoop tag
[Stoop tag	Jacks
Age 8	
Hide and seek	Hide and seek
Tag	Tag
Baseball	Jacks
Washington poke	Washington poke
Stillwater	Jump rope
Age 9	
Tag	Tag
Hide and seek	Jacks
Baseball	Hide and seek
Washington poke	Washington poke
Stillwater	Jump rope
Age 10	
Baseball	Jacks
Tag	Tag
Hide and seek	Hide and seek
[Football	Washington poke
[Washington poke	Baseball
Age 11	
Baseball	Jacks
Football	Tag
Tag	Hide and seek
Hide and seek	Baseball
Run sheep run	Run sheep run

* Bracketing means that those games were equally popular.

TABLE 5

Favorite indoor games of children of different ages

BOYS	GIRLS
Age 7	
Hide the thimble	Hide the thimble
Checkers	Rig a jig jig
Cat and rat	[Checkers
[Brownies and fairies	[House
*[Farmer in the dell	[London Bridge
Pop goes the weasel	
Button button	
Age 8	
Checkers	Hide the thimble
Hide the thimble	Checkers
Dominoes	House
Brownies and fairies	School
Cat and rat	Dominoes
Age 9	
Checkers	Hide the thimble
Hide the thimble	Checkers
Dominoes	House
[Old maid	School
[Basketball	Jacks
Age 10	
Checkers	Hide the thimble
Hide the thimble	Checkers
Basket ball	[Uncle Wiggly
[Volley ball	[Jacks
[Uncle Wiggly	[School
Age 11	
Checkers	Checkers
Basket ball	Jacks
Cards	Hide the thimble
Hide the thimble	Cards
Volley ball	School

tag, another variation, appears twice. Hide and seek also appears in every one of the lists for both sexes.

If we calculate the percentage of children at the different ages who play the various outdoor games, we find certain definite tendencies for interest in certain games. Both sexes show for the ages considered a steadily increasing interest in baseball, run sheep run,

sixty and tennis; boys show an increasing interest also in: canny can, five hundred, football, golf, horseshoes, hockey, marbles, nigger baby, and volley ball. Girls show increasing interest in jump rope, croquet and long ball.

Both sexes show a steady decline in interest in ball, drop the handkerchief, farmer in the dell, London Bridge, stoop tag and shadow tag. Boys show decreasing interest also in catch, cat and rat, pom pom pull away, statue, wood tag and Washington poke.

Games which increase to a maximum between ages seven and eleven and then decline are for both sexes: cop and robber, hide and seek, send after and tag; for boys alone, Chinese tag, cowboy and Indian, stillwater, lead man, croquet, and duck on the rock; for girls , jacks and Washington poke. Other games either show no clear tendencies or appear so infrequently that the changes in the figures may be due solely to chance.

In the lists checkers and hide the thimble stand out as the greatest favorites with checkers in general preferred by the boys and hide the thimble by the girls. Other points to be noted are that house and school, although appearing frequently on the lists of the girls are not present on any list for the boys; on the other hand, basket ball and volley ball are popular with the boys but do not appear on the girls' list. Under "cards" in the age eleven lists we have not included definite card games listed such as "bridge" or "rummy" but we have clung to the children's own naming and counted only the times the children themselves named "cards."

It is interesting to compare the lists of preferred games given above with the results obtained by Lehman and Witty (1) by a different method. These investigators did not attempt to separate outdoor from indoor plays and since they had the children check items on a printed list, without doubt many were checked which the child would not have thought of if left to write the list by himself. They find that the play activities engaged in most often by children between the ages of eight and a half and ten and a half (roughly the group covered in the present study) were: activities involving (1) pleasurable bodily movements, usually rhythmical; (2) hiding and finding; (3) imitation of adults; (4) a relatively high degree of skill; (5) efforts at construction; (6) activities which depend for enjoyment primarily on sense organ stimulation; (7) tag games; and for girls, at least, (8) singing games and ring games. The Lehman and Witty study and the present report agree that boys of seven and eight are much interested in playing baseball, hide and seek, and tag; that boys of nine are much interested in baseball and basketball; and that boys of ten and eleven are much interested in baseball, basketball and football; that girls of seven are much interested in playing house, hide and seek, and tag; and that girls of eight enjoy hide and seek, jump rope and tag. The two studies fail to agree on any games listed as very popular with girls of nine and over. In general, the two reports agree that jacks,

jump rope, school, house, and the singing ring games are definitely more interesting to the girls, while the ball games, marbles and athletic contests are more interesting to the boys.

SUMMARY

1. This paper summarizes lists of outdoor and indoor games which Minneapolis school children from grades one to six recorded as having played within the past year.

2. Of the outdoor games, those of the types of catching and throwing, chasing and fleeing, and hiding and seeking games were most popular with boys and girls of all ages.

3. Boys show more interest than girls in certain games such as the catching-throwing games while girls show more interest in jumping-hopping games.

4. Of the indoor games, the same types appear popular as for out-of-door games with the addition of table games and games involving simple dramatization.

5. Of indoor games boys seem to play catching-throwing games more than girls, while girls play at informal dramatization more than boys.

6. Of the outdoor games listed most frequently tag and hide and seek are universally popular. Boys show especial interest in baseball while girls show considerable interest in jacks.

7. Of the indoor games, checkers and hide the thimble are popular with all ages and both sexes.

8. Older boys show considerable interest in basket ball and volley ball. Girls play jacks indoors as well as outdoors.

9. The findings of this study agree fairly well with those reported by Lehman and Witty.

REFERENCES

(1) LEHMAN, H. C. AND WITTY, P. A.: The psychology of play activities. A. S. Barnes and Co., New York, 1927.